This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

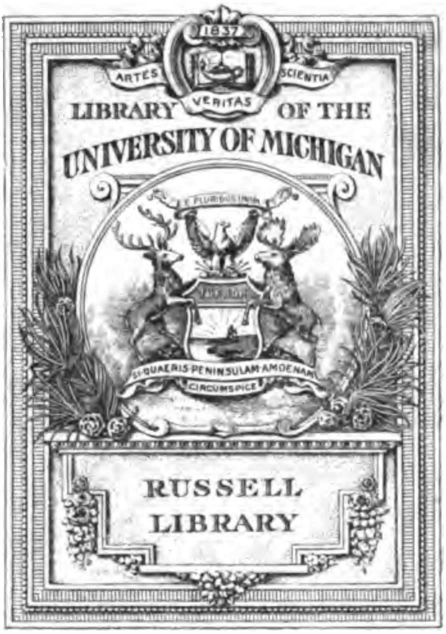
+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

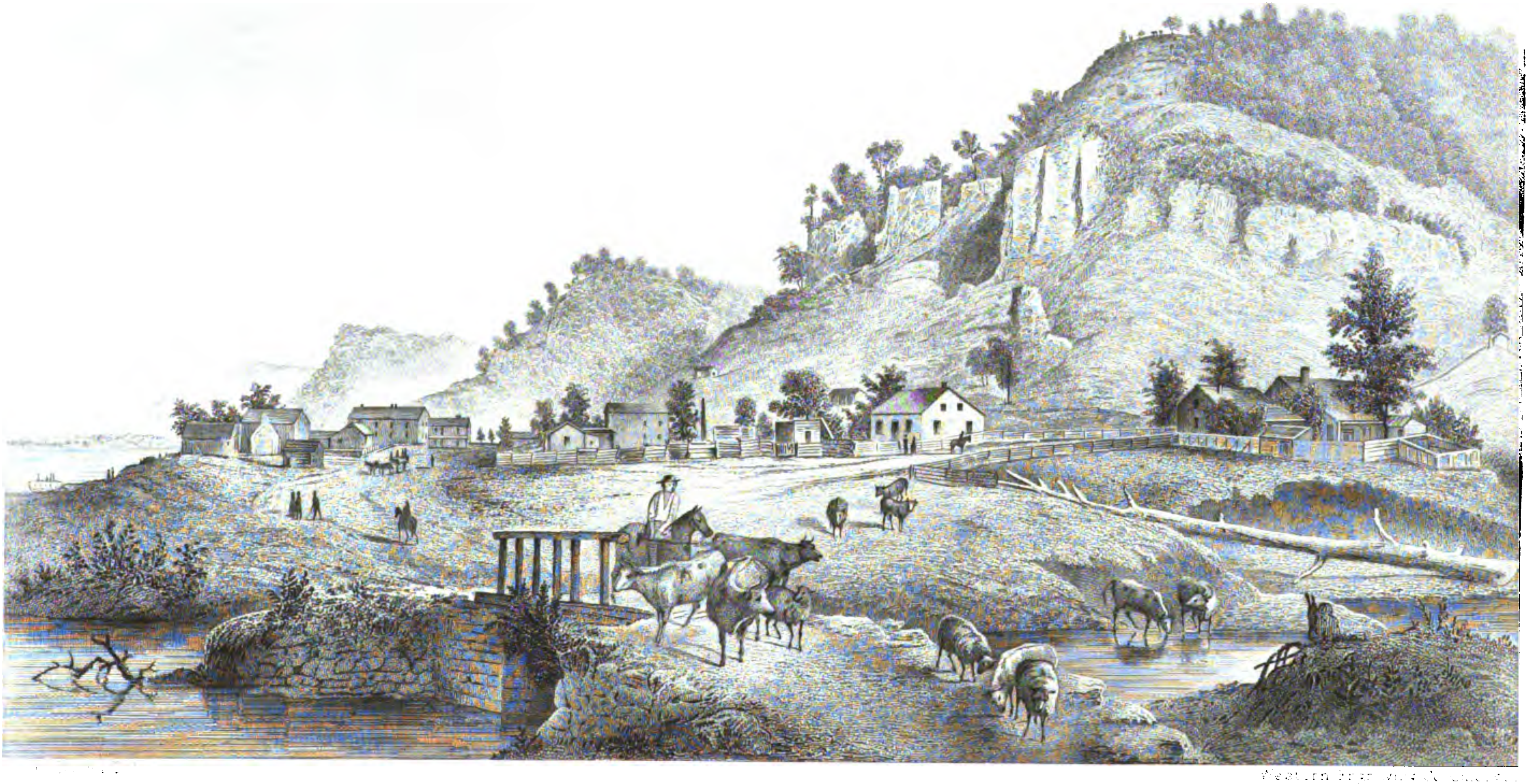
B 478260

D. VAN NOSTRAND
PUBLISHER & IMPORTER
OF
Scientific Books,



1837
ARTES VERITAS SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE
RUSSELL
LIBRARY

SCIENCE LIBRARY
QE
105
.A3



Western Engraving Co. Chicago.

Outcrop of Niagara Limestone.

MASONS LANDING, JERSEY CO.

Fred C. Russell

GEOLOGICAL SURVEY OF ILLINOIS.

A. H. WORTHEN, DIRECTOR.

VOLUME IV.

GEOLOGY AND PALÆONTOLOGY.

GEOLOGY,

BY A. H. WORTHEN,

AND ASSISTANTS,
H. M. BANNISTER, FRANK H. BRADLEY, H. A. GREEN.

PALÆONTOLOGY.

Section I. DESCRIPTIONS OF VERTEBRATES,

BY J. S. NEWBERRY AND A. H. WORTHEN.

Section II. DESCRIPTIONS OF PLANTS,

BY LEO LESQUEREUX.

ILLUSTRATED
BY THE WESTERN ENGRAVING COMPANY, CHICAGO.
PUBLISHED
BY AUTHORITY OF THE LEGISLATURE OF ILLINOIS.
1870.

STATE JOURNAL STEAM PRESS, SPRINGFIELD, ILLINOIS.

TABLE OF CONTENTS.

PART I.

LETTER TO THE HON. JOHN M. PALMER ....Page vii

CHAPTER I.

GEOLOGY OF CALHOUN COUNTY.

By A. H. Worthen.. ....Pages 1 to 23

CHAPTER II.

GEOLOGY OF PIKE COUNTY.

By A. H. Worthen.. ....Pages 24 to 42

CHAPTER III.

GEOLOGY OF ADAMS COUNTY.

By A. H. Worthen..Pages 43 to 61

CHAPTER IV.

GEOLOGY OF BROWN COUNTY.

By A. H. Worthen .... Pages 62 to 74

CHAPTER V.

GEOLOGY OF SCHUYLER COUNTY.

By A. H. Worthen....... ....Pages 75 to 89

151429

CHAPTER VI.

GEOLOGY OF FULTON COUNTY,

By A. H. Worthen........................ ....Pages 90 to 110

CHAPTER VII.

GEOLOGY OF DEKALB, KANE AND DuPAGE COUNTIES.

By Henry M. Bannister...Pages 111 to 125

CHAPTER VIII.

GEOLOGY OF McHENRY AND LAKE COUNTIES.

By Henry M. Bannister...Pages 126 to 135

CHAPTER IX.

GEOLOGY OF KENDALL COUNTY.

By Henry M. Bannister...Pages 136 to 148

CHAPTER X.

GEOLOGY OF MORGAN COUNTY.

By Henry M. Bannister...Pages 149 to 162

CHAPTER XI.

GEOLOGY OF CASS AND MENARD COUNTIES.

By Henry M. Bannister...Pages 163 to 175

CHAPTER XII.

GEOLOGY OF TAZEWELL, McLEAN, LOGAN AND MASON COUNTIES.

By H. M. Bannister......... ....Pages 176 to 189

CHAPTER XIII.

GEOLOGY OF GRUNDY COUNTY.

By Frank H. Bradley........................... ....Pages 190 to 206

CHAPTER XIV.

GEOLOGY OF WILL COUNTY.

By Frank H. Bradley..Pages 207 to 225

CHAPTER XV.

GEOLOGY OF KANKAKEE AND IROQUOIS COUNTIES.

By Frank H. Bradley..Pages 226 to 240

CHAPTER XVI.

GEOLOGY OF VERMILION COUNTY.

By Frank H. Bradley..Pages 241 to 265

CHAPTER XVII.

GEOLOGY OF CHAMPAIGN, EDGAR AND FORD COUNTIES.

By Frank H. Bradley..Pages 266 to 275

CHAPTER XVIII.

GEOLOGY OF HENDERSON COUNTY.

By H. A. Green..Pages 276 to 287

CHAPTER XIX.

GEOLOGY OF WARREN COUNTY.

By H. A. Green..Pages 288 to 300

CHAPTER XX.

GEOLOGY OF MERCER COUNTY.

By H. A. Green..Pages 301 to 312

CHAPTER XXI.

GEOLOGY OF KNOX COUNTY.

By H. A. Green..Pages 313 to 324

CHAPTER XXII.

GEOLOGY OF STARK COUNTY.

By H. A. Green..Pages 325 to 333

CHAPTER XXIII.

GEOLOGY OF WOODFORD COUNTY.

By H. A. Green..Pages 334 to 342

PART II.

PALÆONTOLOGY OF ILLINOIS.

SECTION I.

DESCRIPTIONS OF VERTEBRATES.

By J. S. Newberry and A. H. Worthen........................Pages 346 to 374

SECTION II.

DESCRIPTIONS OF PLANTS.

By Leo Lesquereux..Pages 377 to 508

TO HIS EXCELLENCY

THE HON. JOHN M. PALMER,

GOVERNOR OF THE STATE OF ILLINOIS.

GEOLOGICAL ROOMS,
SPRINGFIELD, *September*, 1870.

SIR: I have the honor of submitting, for publication, the Fourth Volume of my Report on the Geological Survey of Illinois, in accordance with the provisions of the first section of an act passed by the Twenty-sixth General Assembly, and approved March 11th, 1869, entitled, "An act providing for the publication of the fourth volume of the report of the State Geologist, and fixing his salary for the next two years," which section reads as follows:

> *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That the publication of three thousand copies of the fourth volume of the report of the state geologist is hereby authorized, and the sum of seven thousand five hundred dollars is hereby appropriated to defray the cost of the necessary plates, maps, diagrams and drawings; and also the further sum of fifteen hundred dollars, to complete the necessary drawings for the fifth volume of said report; said sums of money to be expended under the direction and by the approval of the governor and the state geologist."

Circumstances entirely beyond my control have prevented the appearance of this volume at an earlier day, and with the present facilities for publication, it is quite impossible to make any reliable calculation upon the time that will be required to place such a volume in the hands of the people, after the material for it has been duly prepared.

The manuscript for the fifth volume is now ready for the printer, and the plates for the engraver, and the materials for the sixth volume are in hand, and will be prepared for publication as rapidly as possible. These two volumes will include the reports on all the remaining counties in the State, and will complete the work of the Survey, in accordance with the plan hitherto pursued.

I have the honor to be
Your obedient servant,
A. H. WORTHEN.

CHAPTER I.

CALHOUN COUNTY.

This county comprises a long, narrow belt of territory, lying in the forks of the Illinois and Mississippi rivers, extending about thirty miles from north to south, with an average width of about eight miles. Topographically, it may be described as a narrow limestone ridge, elevated from two to three hundred feet above the river level, and flanked on either side by the alluvial bottoms of the great rivers, which form its eastern, southern and western boundaries. Over this limestone ridge there has been subsequently deposited beds of Quaternary age, consisting of drift clays, gravel and loess, covering the whole surface to the depth of fifty to one hundred feet. These deposits also fill some of the lateral vallies which intersect the river bluffs, showing that these valleys existed anterior to the *drift epoch.*

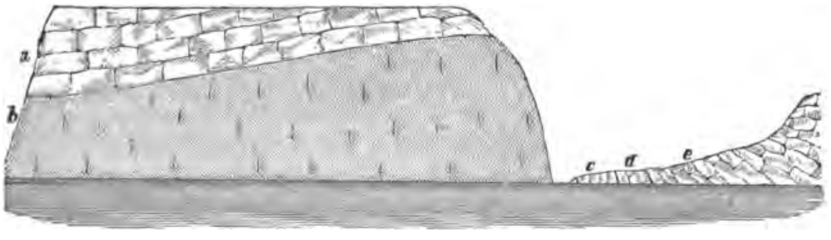
This county is bounded on the north by Pike county, on the east by the Illinois river, and on the south and west by the Mississippi. It embraces an area of a little less than seven townships, or two hundred and fifty-one square miles. It was originally a heavily timbered region, the whole of the uplands and a portion of the bottoms being covered with a heavy growth of timber, embracing the usual varieties of oak and hickory, linden, elm, hackberry, sugar maple, black and white walnut and honey locust; all of which are found on the uplands, while on the bottoms we find cottonwood, sycamore, ash, soft maple, coffenut, hornbeam, pecan, willow, &c. The only stream of any importance in the county, besides the large rivers which form its principal boundaries, is Bay creek, which enters the county near the northwest corner, and after a southeasterly course of about ten miles, empties into the Mississippi about three miles above Hamburg.

The upland region in this county is quite hilly, and some of it is too broken for cultivation, though the soil is productive, and yields abundant crops of all the cereals and fruits usually cultivated in this climate. The heavy deposits of drift-clay and loess that overlie the stratified rocks, determine the general character of the soil, which is but slightly affected by the older formations, except on the steep slopes of the hills, where the limestones and sandstones come to the surface, and by their decomposition, have modified to some extent the soil above them. The marly clays of the loess, form the soil and subsoil over a large portion of the uplands, while the bottoms are covered with a sandy loam, similar in character to that of the principal alluvial valleys of the west.

The geological structure of this county is exceedingly interesting, both from the wide range of formations exposed within its limits, and also from the disturbing influences to which the older strata have been subjected. The *great fault*, which crosses this country below *Cap au Gres*, is the most remarkable disturbance of the stratified rocks to be found within the limits of the State, and to this disturbance is due the wide range of geological formations that appear within the area of this county, comprising the whole range of paleozoic strata, from the St. Peters Sandstone of the Calciferous period to the Coal Measures, and including something over a hundred feet in thickness of the latter group, a wider stratigraphical range of formations than is found in any other county in this portion of the State. This fault intersects the Mississippi bluffs immediately below the high cliff of St. Peters Sandstone, to which the name "*Cap au Gres*," or *Sandstone Headland*, was given by the French *Voyageurs*, and with a trend of east 10° south, it intersects the bluffs of the Illinois about two miles below Monterey, crosses to the bluffs on the eastern side of that stream, about five miles above its mouth, and after intersecting an elbow of the river bluff in Jersey county for three or four miles, it is finally lost in the valley of the Mississippi. The strata have not only been dislocated by this disturbance, but there has also been a down-throw of the beds, to the extent of at least seven or eight hundred feet on the western side of the fault, while on the east, they remain but slightly elevated above their original horizontal position, and are seen dipping gently to the northeastward.

To the northward of this axis, the Burlington limestone forms the bed rock at the summit level of the dividing ridge between the two rivers, up to, and beyond the Pike county line, while to the southward, nearly all the highlands are directly underlaid by the St. Louis limestone or the Coal Measures. The exact line of this fault is hidden in the valley of a small stream, which enters the Mississippi just below the *Cap au Gres* bluff, but immediately below this valley the Lower Carboniferous limestones are seen standing in a nearly vertical position, dipping south 10° west.

The following wood cut will serve to illustrate the relative position of the strata at this point, showing the *Cap au Gres* bluff of Lower Silurian strata on the left, and the upturned edges of the Lower Carboniferous limestones immediately below it on the right:



a. Trenton Limestone. *c.* Burlington Limestone. *e.* St. Louis Limestone.
b. St. Peters Sandstone. *d.* Keokuk "

We are unable to fix the exact period when this disturbance took place, but it seems to have been anterior to the coal epoch. This is indicated by the unconformability of the coal strata to the underlying limestones on the north side of this axis in Pike and Adams counties, where the Coal Measures rest unconformably on the Keokuk and Burlington limestones, showing that these beds had been elevated, and a considerable thickness of strata removed by denudation, before the deposit of the coal. Southwest of this axis, the coal rests on the St. Louis limestone, but whether exactly conformable to it or not, we can not say, from the partial exposures we were able to examine.

The following section exhibits the different formations that may be seen in this county, showing their relative position and thickness. This section presents a thickness nearly equal to one-half of all the stratified rocks found in the State, and, with the exception of the middle and upper Coal Measures, and the Chester group of the Lower Carboniferous limestone series, it comprises all the important divisions of the paleozoic strata to be found in the State.

	FEET.
Loess	40 to 60
Drift, clay and gravel	10 " 20
Coal Measures	100 " 120
St. Louis limestone	200
Keokuk group	150
Burlington limestone	200
Kinderhook group	120
Hamilton limestone	6 " 15
Niagara "	50 " 75
Cincinnati group	80 " 120
Trenton limestone	350 " 400
St. Peters Sandstone	150
Maximum thickness	1,630

The St. Peters Sandstone.—This is the oldest rock appearing above the surface in this county, and its only point of outcrop is at the *Cap au Gres* bluff, on section 30, town 12 south, range 2 west. It forms the lower escarpment of this bluff, which is about a mile in extent on the river, but it dips strongly to the northeastward and disappears below the succeeding formations so rapidly, that it is nowhere seen except at this point. The lowest portion of the bed does not appear above the surface, but there is about one hundred and fifty feet in thickness exposed at the lower end of the bluff, which gradually passes beneath the magnesian beds of the Trenton group towards the upper extremity, making its entire outcrop along the river a little more than a mile in length. It is a purely silicious rock, made up of minute grains of quartz that are sometimes scarcely cemented at all, and some portions of it readily crumble to sand on exposure. Other portions of the mass are tolerably well cemented by the infiltration of the oxyd of iron, and the rock then forms a bold mural precipice along the river bank. A section of this bluff, made nearly midway between its northern and southern extremities, shows the following order:

	FEET
Loess capping the bluff	60
Light-gray Trenton limestone	8
Brown and buff magnesian limestone	70
St. Peters Sandstone	130

The sandstone is irregularly stratified, and often concretionary, showing no well defined lines of bedding. It may be regarded as the equivalent, in part, of the Calciferous group of New York, and corresponds to the Saccharoidal sandstone of Missouri. No organic remains have yet been found in it, either in this State or elsewhere.

Trenton Group.—This group, as it is developed in this county, consists of brown and buff magnesian limestones at the base of the series, which attain a thickness of about seventy feet. These are succeeded by fine grained, compact, gray and chocolate brown limestones forming the middle divisions of the series, and these are overlaid by a rather soft, coarse grained, yellowish gray limestone, forming the upper division of the group. Its aggregate thickness may be estimated at three hundred and fifty to four hundred feet. Its most northerly outcrop in this county, is at the foot of the Mississippi bluffs, about three miles below Gilead P. O., on the northeast quarter of section 31, town 11, range 2 west, though it was found only about three feet below the surface in digging a well on the southwest quarter of section 29, in the same township. The rock where it first appears in this vicinity, is a light yellowish gray, coarse grained limestone, rather soft and very uneven in texture, and weathers on exposure with an uneven and ragged surface. It is rather thin bedded at the top, but becomes more massive below, and the strata rise in a southerly direction so rapidly that about two miles below the point where the rock first appears, it forms a perpendicular cliff from eighty to a hundred feet in hight. A few fossils were obtained from these coarse grained limestones, among which were *Strophomena alternata*, *Orthis lynx*, and a ramose form of *Chætetes*. Below this coarse grained limestone, we find about fifteen or twenty feet in thickness of fine grained, chocolate colored, thin bedded limestone. It weathers to an ash gray color, and the strata are generally from two to four inches in thickness.

Descending along the river bluffs below the outcrop of these limestones, we find them underlaid by a series of light gray, compact, fine grained limestones, partly thin bedded, but affording some massive strata in the lower part of the series These limestones continue to form the main portion of the river bluff down to the small creek which intersects the bluffs just above the *Cap au Gres* ferry landing. At this point the upper layers of the brown and buff limestones, which form the lower division of the group, are seen just above the creek level.

On Cave Spring Branch, a small creek which intersects the bluffs about a mile and a half above the ferry landing, the upper portion of the Trenton limestone is well exposed, forming the bed and bluffs of the creek for a mile or more from its mouth. The thin bedded, chocolate colored limestone, is also well exposed on this creek, and is here quite arenaceous and passes into a fine grained calcareous sandstone. Some of the light gray compact limestones below this chocolate colored bed, are filled with marine plants, or *fucoides*, which are well exposed on the weathered surfaces of the rock. Trilobites are not uncommon in these limestones, and fragments of *Asaphus megistos*, *Ceraurus pleurexanthemus*, and *Illenus ovatus* were obtained here. They are associated with two or three species of *Orthocera*, and the common *Brachiopoda* of this horizon.

The lowest division of this group consists of evenly bedded, buff or brown dolomitic limestones, which attain a thickness of about seventy feet, and are seen overlying the St. Peter's sandstone at the upper end of the *Cap au Gres* bluff, the only point where they are found well exposed. The beds vary in thickness from four inches to two feet or more, and the dip is so strong to the northeastward, that this division of the group only outcrops over a very limited area, in the immediate vicinity of the river bluffs. Indeed, the whole of this group, nearly or quite four hundred feet in thickness, covers in its outcrop in this county, an area of only about three or four square miles.

Cincinnati Group.—The Trenton limestone is immediately overlaid in this county, by blue and green, partly indurated clays, which attain an aggregate thickness of about a hundred feet, and although they have afforded no fossils, their stratigraphical position, and lithological characters, are sufficient to determine their position in the geological series, as the equivalents of the Cincinnati group of our general section of the Illinois strata. These clays are seldom found well exposed, but partial outcrops are occasionally seen on the slopes of the hills, either on the small streams or gulches, which intersect the river bluffs along their line of outcrop. They are often met with in digging wells in the region which they underlie, and where the Upper Silurian limestone is wanting, this group forms low rounded hills, or gentle slopes, that seldom afford any good exposure of the underlying strata, although they may be but a few feet beneath the surface. Their first appearance on the eastern side of the county on descending the river bluffs, is between Hamburg and Gilead, where they are occasionally seen cropping out beneath the Niagara limestone, which here forms the upper part of the bluff. When exposed at the surface, they form a tough, blue plastic clay, very much like the potter's clays of the coal formation. On the northwest quarter of section 19, township 10, range 2, west, they outcrop beneath the Niagara limestone, and extend down to the river level and below, showing a thickness above the river, of about forty or fifty feet. Gradually rising in a southerly direction, they are found in the vicinity of Gilead about one hundred feet or more in thickness, but seldom well exposed. From this point, their outcrop trends southeastwardly across the county, following the direction of the *Cap au Gres* fault, and appearing in the Illinois river bluffs, on the eastern side of the county, in the vicinity of Monterey, where they form the base of the bluff, and are overlaid by the Niagara and Hamilton limestones. From this point northward, they are occasionally seen at the base of the bluffs for two or three miles, when, with a gentle northeasterly inclination, they pass below the level of the Illinois bottoms, and are seen no more. No calcareous or arenaceous strata, were found associated with this group in this county, and it appears to be composed entirely of fine argillaceous sediments.

Niagara Limestone.—This is one of the most important formations in the county, and is well exposed at many points in the river bluffs, on both the east and west sides of the county. On the west, it appears at the base of the bluff near the north line of the county, forming a low bench of light gray limestone, from fifteen to twenty feet above the river level, and thence extends down nearly to the mouth of Bay creek, where, by an indulation of the dip, it sinks below the level of the river, and does not appear again above Hamburg. At that point it again rises above the river level, and at the mouth of the small creek, which enters the river on the lower side of the village, there is an outcrop of the upper part of this formation, about twenty feet in thickness, over which the creek forms a cascade just above its mouth. The rock is here a compact bluish gray limestone in regular beds, from six inches to a foot in thickness. It has a moderate dip to the northward, and a half mile below this point, where another creek enters the river, a measured section showed about forty-five feet of this limestone above the river level. At all the localities where this formation was seen, from the north line of the county to a point some two miles below Hamburg, the rock is of a bluish gray color, and usually even bedded, but south of this, it changes to a light brown or buff color, and presents the characters of a true dolomite. In the vicinity of Hamburg it is immediately overlaid by a brownish gray, arenaceous, Devonian limestone, and this is succeeded by the limestones and shales of the Kinderhook group. The following section will show the relations of these different formations as they appear in the vicinity of Hamburg, including all, to the highest point of the bluff:

		FEET.
Loess forming the summit of the bluff		60
Burlington limestone		40
Shaley ash colored limestones (Kinderhook)		40
Greenish sandy and argillaceous shales (Kinderhook)		60 to 70
Slaty oolitic limestones	"	10 to 15
Fine grained light blue limestone	"	4 to 20
Green shale	"	1 to 3
Hamilton limestone (Devonian)		4 to 8
Niagara limestone (Up. Silurian)		40 to 50

The Niagara limestone extends below the river level, at all the exposures in the vicinity of Hamburg, and its entire thickness is not seen. On the northwest quarter of section 19, township 10 south, range 2 west, the rock was quarried for the jail at Hardin. At the base of this formation here, where it rests on the blue clays of the Cincinnati group, we find from two to four feet of light gray oolitic limestone forming the lower beds, which are overlaid by the buff and brown dolomitic limestones in which the quarries for building-stone were opened. These beds are here about fifty feet in thickness, and probably comprise nearly the whole thickness of the Niagara group at this point, for on the adjoining section, on the small creek which intersects the bluffs on section 18, township 10 south, range 2 west, the Hamilton limestone is found in place overlying the Upper Silurian strata.

From this point south, to a point a mile below Gilead, these limestones continue to show themselves in occasional outcrops, forming the upper portion of the bluff, while below, there is a sloping talus, underlaid by the blue argillaceous clays of the Cincinnati group. Below Gilead, the line of outcrop of the Niagara limestone, and overlying formation recedes from the river bluffs, and is found in the hills from one to two miles back, towards the interior of the county. It continues in a southerly direction to section 28, township 12 south, range 2 west, where its trend is changed to the eastward across the county, by the disturbing influences that caused the *Cap au Gres* fault.

Its most southerly outcrop on the eastern side of the county, is in the vicinity of the Stone Church, two miles below Monterey, where about twenty feet in thickness of buff limestone is exposed, and has been quarried for building-stone in this neighborhood. Between this point and Monterey this limestone is mostly hidden under the overlying Lower Carboniferous formations. At Mr. C. W. Twitchell's place on the southeast quarter of section 10, township 12 south, range 2 west, this limestone has been quarried, where it forms a precipitous bluff some forty to fifty feet high.

At the point of the bluff above Monterey on the Hardin road, on the northeast quarter of section 11, in the same township, the following measured section was obtained:

	FT.
Hamilton limestone	12
Buff colored Niagara limestones	50
Covered slope with partial outcrops of blue clays	48

The blue clays forming the lower part of this section undoubtedly belong to the Cincinnati group, and, though the junction of the Upper and Lower Silurian strata could not be seen here, it is probable that nearly the full thickness of the Niagara limestone is represented in the above section, as this is about its average in this part of the county. From this point northward along the bluffs of the Illinois river, the brown and buff limestones of this group continue, in occasional outcrops at the foot of the bluffs, for about six or eight miles, when the color of the beds change to a bluish gray, very much like the beds in the vicinity of Hamburg, and from thence northward, only a few feet in thickness of the upper part of this formation is seen. A half mile above Hardin, there is about twenty-five feet of the upper part of this formation exposed above the level of the river at low water, consisting of rough, irregular bedded, bluish gray limestones. From this point northward, to the small creek which empties into the Illinois about three-quarters of a mile below Farrowtown, we find occasional outcrops of the upper part of this limestone, and on this creek which is the most northerly outcrop known on this side of the county, there is about ten or twelve feet of the upper part of this group exposed, consisting of even bedded, fine grained limestones, that may be seen for a distance of two or three hundred yards to the westward of the road. But few fossils were obtained from this formation in this county, though the beds in the vicinity of Monterey seemed to be quite as fossiliferous as this rock usually is in this portion of the State, and when the quarries here are worked to any considerable extent, as they now are at Grafton, they will, no doubt, afford a good many interesting forms of organic life.

Hamilton Limestone.—This is the only division of the Devonian system, that has been identified in this county, and consists of from six to twelve feet of brownish gray limestones, that are usually very hard and silicious, and sometimes pass into a coarse quartzose sandstone. At the most northerly outcrops of the Niagara limestone in this county, there seems to have been no development of the Hamilton beds, and the Upper Silurian limestones are immediately overlaid by the shales and limestones of the Kinderhook group.

On the west side of the county, the first exposure of this limestone met with, below the north line of the county, was on the northeast quarter of section 20, township 8 south, range 3 west, where a stratum of white sandstone, about a foot in thickness, was found resting upon the Niagara limestones. No fossils were obtained from the sandstone at this locality, but further south a similar sandstone abounds in the characteristic fossils of this group, leaving no doubt as to the age of these arenaceous strata. In the bed of the small creek, which enters Bay creek about five miles above Hamburg, there is about six feet in thickness of coarse brownish gray limestone exposed, filled with characteristic Devonian fossils, among which are two or three species of *Spirifers*, *Atrypa recticularis*, *Orthis Iowensis*, and several of the common corals of this group, among which were large masses of a coral which has usually been referred to the genus *Acervularia*, and has been called *A. Davidsoni.** At an old mill, a short distance below this point, these thin bedded limestones were eight feet in thick-

---

*On referring this coral to Dr. Rominger, of Ann Arbor, Michigan, one of our best authorities on fossil corals, he has pronounced it a true *Cyathophyllum*.

ness, and were overlaid by two feet of green shale, which was succeeded by the fine grained light blue limestone of the Kinderhook group.

At Hamburg this limestone is also exposed, and is about six feet in thickness. The upper layers are quite arenacious and pass locally into a quartzose sandstone. From this to Gilead, this limestone was met with at every locality examined, where its proper horizon could be seen, and its characteristic fossils are frequently met with, weathered out on the sloping hill-sides below its outcrop. Just below Gilead, its outcrop trends eastwardly, leaving the river bluffs, and it was next seen a few hundred yards to the eastward of the *Salt Spring*, on section 16, township 11 south, range 2 west. In this vicinity it is quite silicious, and passes into a sandstone, which is filled with beautiful silicious casts of some of its most characteristic fossils. I am indebted to Mr. Wm. McAdams, of Otterville, in Jersey county, for some of the fossils of this sandstone obtained in the vicinity of the *Salt Spring*.

The most southerly point, where we found this limestone exposed on the eastern side of the county, is on the southeast quarter of section 11, township 12 south, range 2 west, just above Monterey, where it caps a bluff of Niagara limestone. It is here quite silicious and thin bedded at the top, but becomes more massive below. At Mr. Belt's place, near the north line of section 35, township 11, range 2 west, we found this limestone well exposed, and a quarry opened in it, on our first visit to the county in 1853. The bed is here about twelve feet thick, and the rock is quite evenly bedded, the layers generally ranging from four inches to a foot in thickness. It abounds in fossils, among which are *Spirifer Wortheni*, *Atrypa recticularis*, and several species of *Zaphrentis* and *Heliophyllum*. From this point northwardly, this limestone may be seen outcropping along the base of the bluff, nearly to the north line of township 10 south, range 2 west, beyond which point it was not seen. A half mile above Hardin, it is found overlying the Niagara limestone, the latter formation occupying the lower twenty feet or more, above the river level. It is here about eight feet in thickness, the lower portion quite thin bedded, but becoming at the top, a hard grey limestone, in thicker strata. Fossils are quite abundant here, especially corals, which are found weathered out of the limestone, and are mingled with the debris composing the shingle of the river bank. This limestone is closely associated with the Niagara group, which it immediately overlies in this county, and its outcrop is entirely restricted to localities where the Niagara limestone also appears above the surface.

Kinderhook Group.—At the base of the Lower Carboniferous series in this State, we find a group of rocks, mainly sedimentary in their origin, consisting of shales, shaly sandstones and thin beds of limestone, but locally becoming quite calcareous, and passing into thin bedded, ash colored, shaly, and magnesian limestones. At some points in this county, the upper portion of this group is represented by thin bedded, ash colored, shaly limestones, the equivalent of the *Choteau limestone* of the Missouri Report, which are underlaid by sandy and argillaceous shales, with thin beds of oolitic, and fine grained limestones at the base. The following section, made in the vicinity of Hamburg, will show the average thickness, and order of succession, of the various beds of this group:

	FEET.
Thin bedded shaly limestones	30 to 40
Sandy and argillaceous shales	40 to 50
Oolitic limestone	3 to 10
Fine grained, light blue or dove colored limestone	4 to 12
Green shale, sometimes partially bituminous	2 to 15

These beds are seldom well exposed in this county, as they underlie the Burlington limestone, which generally forms the upper escarpment of the bluffs, and they are consequently mostly hidden under the sloping talus beneath. From the north line of the county to Hamburg on the west, and to the south line of town 11 south, range 2 west, on the eastern side of the county, this group may be found in partial exposures either in the face of the bluffs below the perpendicular limestone escarpment, or in the ravines by which the bluffs are intersected. In the vicinity of Hamburg this group is well exposed in the banks of the small creek just below the village, showing exactly the order of succession to be seen in the above section. The green shale at the base of the group rests directly upon the Hamilton limestone, and may be the representative of what has been sometimes called "Black-slate" formation, but in the absence of any evidence that it is of Devonian age, we have included it in this group, with which it seems to be identified more closely than with the beds below. Above this we find the light bluish gray silicious limestone, sometimes called the "Lithographic" limestone, which is variable in its thickness in this county, ranging from four to twenty feet. A few fossils were obtained from this rock in the vicinity of Hamburg, among which were *Productus pyxidatus*, *Spirifer Marionensis*, *Cyrtia acutirostris*, and an *Orthis* like *O. Michelini.* On the eastern side of the county, we did not find this limestone exposed. It rereceived the name of "Lithographic" limestone from its resemblance to the stone used in lithography, but some examples of it which have been tested for that purpose, have not shown the necessary qualities of a good lithographic stone. It is regularly stratified, in beds varying from two inches to a foot in thickness, but they are intersected by numerous seams and cross fractures, so that good slabs of any considerable size are not easily obtained. This character alone would render it unfit for the lithographer. This limestone is succeeded by a thin bedded oolitic limestone, which, in the vicinity of Hamburg ranges from five to ten feet in thickness, and splits readily into thin layers of an inch or less in thickness. A portion of it is quite fossiliferous in the vicinity of Hamburg, and has afforded the following species: *Rynchonella pustulosa*, *Spiriferina subtexta*, *Leda Barrisi*, and a *Terebratula* resembling *T. hastata*.

On the eastern side of the county we found an oolitic rock exposed on Mr. Whitaker's place, northwest quarter of section 27, town 8 south, range 2 west, which probably should be referred to this horizon. The lowest rock seen at this point is a blue argillaceous shale, with some thin layers of limestone strongly impregnated with the sulphuret of iron. This shale was overlaid by a bed of oolitic conglomerate, closely resembling that found at Rockport in Pike county. It is here from four to five feet in thickness, one-half of which constitutes but a single layer, and the remainder is in thin beds, from two to six inches thick. This was the only point where we found it exposed on the eastern side of the county.

These oolitic beds are generally succeeded by argillaceous and sandy shales, which vary in thickness from forty to eighty feet, and are argillaceous at the base and arenaceous at the top, passing into shaly gritstones. These beds contain but few well marked fossils in this county, except a large fucoid, like the *Cauda Galli* of the New York corniferous beds, which is quite abundant in the shaly gritstones of this group. Its occurrence in these beds has been urged as an evidence of the Devonian age of this formation, but a similar fucoid is found high up in the Coal Measures in Illinois, and hence no satisfactory conclusion as to the age of any formation could be predicated upon the occurrence of this peculiar fossil in it. At Reed's Landing, in the northeast part of the county, this fucoid is quite abundant in the thin gritstones which form the upper portion of the group in that vicinity.

At Hamburg the upper beds of this group become calcareous, and form an ash-gray shaly limestone, twenty-five to thirty feet or more in thickness. Some of the beds are magnesian and partly concretionary in their structure, and contain a few fossils, among which are *Strophomena analoga*, *Euomphalus latus and Productus semireticulatus*. It may be that these magnesian and shaly limestones are the stratigraphical equivalents of the lower division of the Burlington limestone, but they contain very few crinoidal remains here, and these are generally too fragmentary to be specifically determined.

About three-quarters of a mile north of Brussels, there is an outcrop just above the level of the Illinois bottoms, of a striped purple and green oolitic conglomerate. The quarry exposes about four feet in thickness of the rock, which lies in thin beds from two inches to a foot in thickness. It is overlaid by about three feet of fine grained limestone, apparently the equivalent of the so called "*Lithographic*" limestone of the Kinderhook group. No similar rock has been found anywhere else in the State, and we are only able to determine the horizon to which it belongs, from its connection with the overlying limestone. From its association with that limestone we refer it without hesitation to this group, and consider it as probably replacing the green shale, which forms the base of the group at nearly all the other localities, where we found the lower beds exposed in this county. This is the only point south of the *Cap au Gres* axis, where we met with any exposure of the Kinderhook beds, in the county.

Burlington Limestone.—This division of the Lower Carboniferous series, outcrops over a wide area in this county, and forms the bed-rock over nearly all the high lands north of the *Cap au Gres* axis. It forms the upper escarpment of the river bluffs, from the north line of the county, to Hamburg on the west, and to the vicinity of Monterey on the east, and also outcrops on most of the small streams in the northern part of the county. Its entire thickness ranges from one hundred and fifty to two hundred feet, but it is usually only partially exposed, a considerable portion of it being hidden, either in the covered slope at the top of the bluff, or in the sloping talus below.

At Reed's Landing, about two miles and a-half below the north line of the county, the bluffs of the Illinois are about two hundred and forty feet in hight, nearly one-half of which is Burlington limestone, forming a natural cliff a hundred feet or more in hight. Below the limestone cliff, there is a sloping talus, to the level of the bottoms bordering the river, covering the shales of the Kinderhook group, which probably extend from the base of the limestone down to the river level. This limestone is generally coarse grained or granular in texture, of a gray or brownish gray color, and tolerably regular bedded, the strata varying from four inches to two feet in thickness. It contains a good deal of cherty or flinty material, which occurs either in nodules, or in regular seams intercalated in the limestone strata. The term "*Crinoidal limestone*," which has sometimes been applied to this rock, is very applicable to the upper portion of it in this county, as it is almost entirely composed of the remains crinoidea, and other marine animals, cemented by calcareous matter. The chert with which the limestone abounds, is also filled with the silicified remains of these marine animals, and it affords exquisite casts, in flint, of the internal structure and markings of many of the organic bodies of which this limestone is so largely composed. Casts of several species of *Actinocrinus*, one species of *Platycrinus* and *Granatocrinus Norwoodi*, were obtained from the chert nodules at this locality, and from the limestone we obtained *Spirifer Grimesi*, *Strophomena analoga*, and *Euomphalus latus*. The lower portion of this limestone here, as elsewhere in this county, consists of alternations of gray and light yellow, or brown, earthy or magnesian limestone, only slightly crinoidal in its character, but finer grained and more compact than the upper beds. It contains very few well preserved crinoids, though detached columns and crushed bodies are frequently met with. In some respects, these brown beds would seem to correspond to the lower division of this formation at Burlington, Iowa, but the fossils obtained here are too few and imperfect to enable one to identify the strata with those at more northern localities, where fossils are abundant and well preserved. From Reed's Landing to Farrowtown, this limestone forms a continuous cliff, except where it is intersected by the vallies of the small streams, the bluffs ranging from two hundred to two hundred and fifty feet in hight.

These bluffs continue, with but slight interruption, to Hardin, where they are fully two hundred and fifty feet in hight, the upper escarpment being formed by the lower portion of the Burlington limestone, the sloping talus below covering shaly limestones and shales of the Kinderhook group, while near the river level we find the upper portion of the Niagara limestone, overlaid by the Hamilton.

The following section shows the thickness, and order of succession of the beds forming the bluff a half mile above the town:

		FEET.
Loess capping the bluff		30 to 40
Burlington limestone		70 " 80
Kinderhook...	Thin bedded limestone and shale	80 " 85
	Slaty limestone	10
	Fine grained, light blue limestone	5
Hamilton limestones		8 " 10
Niagara limestone		20

These beds are mostly hidden beneath the sloping talus of the bluff, except the upper and lower limestones, the former outcropping at the top of the bluff and the latter on the river bank, and on the small creeks by which the bluffs are intersected.

Following down the river bluffs, below Hardin, these beds continue, with but slight variation, to the south line of town 11 south, range 2 west, where the high bluffs terminate on the eastern side of the county. At Mr. Belt's place, about three miles above Monterey, the following measured section was made in 1853, on our first visit to this county:

	FT.
Loess capping the bluff, not measured.	
Burlington limestone	50
Shaly ash gray limestones	95
Blue clay shale	18
Hamilton limestone	12
Slope covering Niagara limestone	40

Two miles below this, the Burlington limestone disappears for about two miles, and the bluffs, which are comparatively low, are formed by the older formations, but a mile below Monterey, it comes in again, capping the bluff for a short distance, with a strong dip to the northeastward from its proximity to the *Cap au Gres* axis. It extends down to the southeast quarter of section 14, town 12 south, range 2 west, which is the most southerly point where it was seen. On the other side of the fault, on the northeast quarter of section 35, town 12, range 2 west, there is about twenty-five feet in thickness of this limestone to be seen, dipping south 20° west, at an angle of about 24°. This is the most southerly exposure of this rock that has been seen in the county.

On the west side of the county, on the north line, this limestone forms the upper escarpment of the bluff, and in crossing the county from Reed's Landing to Bay creek, through the north tier of townships, it forms the bed rock over all the highlands between the two rivers. Following down the Mississippi, it forms almost continuous exposures along the bluffs on the west side of the county, to Hamburg, where the upper escarpment of the bluff is formed in part of this limestone, and in part by the limestones of Kinderhook group. From this point, its outcrop trends eastwardly, and the underlying formations take its place in the river bluffs, but it continues to form the upper portion of the dividing ridge between the two rivers, down to the center of town 12 south, range 2 west, which is its most southerly point of outcrop in the interior of the county, on the north side of the *Cap au Gres* fault. Below that fault, it is only seen at one point on the west side of the county, where the upturned edges of its nearly vertical strata, constitute the first rock exposure below the *Cap au Gres* bluff. This exposure is about two hundred yards below the southern terminus of the sandstone bluff, and the strata are in a nearly vertical position, dipping south 20° west, at an angle of at least 60°. A measurement across the upturned edges of the strata, indicated a thicknsss of about two hundred feet. The Kinderhook shales and limestones are not exposed here, but probably underlie a part of the valley of the small creek which enters the river at this point. The Keokuk limestone is found immediately succeeding the Burlington here, but with a diminished dip, and it is overlaid by the St. Louis limestone, the upper portion of which holds a nearly horizontal position. The wood cut on page 2 illustrates the position of the various formations seen in connection with this fault, much more clearly than any verbal description that could be given.

Keokuk Limestone.—This division of the Lower Carboniferous series is only met with at the single locality above mentioned in this county. It immediately succeeds the Burlington limestone below the *Cap au Gres* bluff, and, although the dip is considerably less than that of the underlying limestone, it is nevertheless sufficiently strong to carry all the exposed beds of this group below the surface, in a distance of about one hundred and fifty feet. Its entire thickness here, probably, does not exceed one hundred feet, though an accurate measurement could not well be made here. The upper portion appeared to be shaly, and was filled with the silicious geodes, characteristic of the upper part of this group at more northern localities. The lower portion was composed of gray limestones, similar to the quarry rock at Hamilton and Nauvoo. On the eastern side of the county, it should be found between the outcrop of Burlington limestone, on section 35, township 12 south, range 2 west, and the St. Louis limestone, which appears a short distance below, but no exposure of it was found in this part of the county.

St. Louis Group.—The Keokuk limestones, at the outcrop below the *Cap au Gres* bluff, are succeeded by beds of brown magnesian limestone, some sixty or seventy feet in thickness, which form the lower division of this group. They dip at a moderate angle in the same direction as the lower beds, and are overlaid by compact gray limestones which are nearly horizontal in their position, and form a perpendicular bluff from forty to fifty feet high. From this point to Johnson's Landing, these gray limestones, which, in the aggregate, are probably a hundred feet or more in thickness, form a continuous line of bluffs from fifty to seventy-five feet in hight, and a short distance back from the river are overlaid by the Coal Measures. The gray limestones which form the upper portion of this group are even bedded, and partly concretionary, or brecciated in their structure. At Johnson's Landing, now better known as Bell's Landing, the upper portion of this limestone forms the bluff for thirty or forty feet above the river level, consisting of compact gray and brown limestones, separated by partings of clay shale, in which the fossil corals of this group, *Lithostrotion canadense*, *L. prolifera*, and an undetermined *Syringopora*, are quite abundant.

Below this landing, the bluffs of the river trend to the eastward, and some of the lower beds come again to the surface, and continue gradually rising to the old town site of Milan, where the limestone bluffs end on the western side of the Illinois river valley. On the eastern side of the county, below the *Cap au Gres* axis, there are but few exposures of this limestone, although it undoubtedly continues along the bluffs on this side of the valley, for three or four miles above their southern extremity. North of this axis, the St. Louis limestone has not been found in this county, but south of that point, it forms almost the entire limestone exposure.

Coal Measures.—This formation, like the St. Louis limestone, is restricted in its developments to the southern part of the county, and is found underlying a considerable portion of the high lands below the *Cap au Gres* axis. Commencing about two miles below this axis, it underlies the highest portion of the county, in township 13, in ranges 1 and 2 west, though exposures of the strata are rarely met with, and consequently its boundaries cannot be very definitely determined. The only coal mine that has been worked to any extent in this county, is Williams's mine, located on a fraction of section 1, township 14, range 2 west, about one mile above Fruitland, and two miles above Bell's, formerly Johnson's Landing. These mines were opened nearly twenty years ago, and have been worked, at intervals, down to the present time. The following section, made at these mines, will show the character and succession of the beds, and is, perhaps, as complete a section of the Coal Measure deposits as could be made at any locality in the county:

	FT.	IN.
Brown shale	6	
Hard, gray, concretionary limestone	4 to 6	
Covered slope, with partial outcrops of shale	50	
Brown, sandy shale	15	
Coal	0	4
Clay shale and iron ore	2	6
Coal	2	2
Fire clay	2 to 3	
Clay shale, passing downward into bituminous shale	12	
Sandstone and sandy shale	20 to 25	
St Louis limestone, to river level	30	

The main coal seam at this point, ranges from twenty-four to thirty inches in thickness, and affords a coal of fair quality, though as the work had been suspended for some time when we last visited the locality, the opportunity for examining the coal was not as good as could be desired. It seemed to be rather free from pyrites, and the analysis, which will be found on a subsequent page, shows its quality to be fully equal to the average of western bituminous coals. It is overlaid by about thirty inches of clay shale, the upper part of which is quite ferruginous, and forms an impure iron ore about a foot in thickness. Above this, there is another thin seam of coal, which was four inches thick at the only point where we found it exposed. These coals are overlaid by a thick bed of brown shale, which was only partly exposed, but appeared to be about sixty-five feet in thickness, above which was a bed of hard, gray, concretionary limestone, from four to six feet or more in thickness, and above this we saw a few feet of brown shale, which was the highest bed of the Coal Measure series met with in the county. The concretionary limestone contained a number of species of Coal Measure fossils, among which we collected, *Spirifer lineatus*, *Athysis subtilita*, *Terebratula bovidens*, *Productus semireticulatus*, *Fusulina*, sp? andjoints of *crinoidea*, and small turbinated corals.

Below the main coal seam there are two or three feet of fire clay, which passes downward into a black shale, which is said to have been reached at the depth of fourteen feet below the coal, but was not penetrated. This black shale probably represents another coal seam, which may be developed at some point in the county thick enough to be worked. Between this and the St. Louis limestone, we found a partial outcrop of sandy shale and sandstone about twenty-five feet in thickness, which forms the base of the Coal Measure deposits in this county. The Coal Measures, as developed here, seem to include the horizon of at least three coal seams, the lowest being represented by the black shale; but so far as could be learned from the few openings made in attempting to mine coal in this county, only one seam has yet been found of sufficient thickness to be worked. On Mr. Wm. Love's place, the northwest quarter of section 10, township 13, range 2 west, the gray concretionary limestone which is found sixty-five feet above the coal at Williams's mine, outcrops on the south side of the hill, about a quarter of a mile south of his dwelling; and probably the whole thickness of the measures, as developed in this county, are to be found here, though there is no exposure of the beds below this limestone in this vicinity. Coal has been found on the southeast quarter of section 26, on the northeast of 36, and on the northeast of 24, township 13, range 2 west, and the Coal Measures, probably, underlie fully one-half of the high lands in township 13, ranges 1 and 2, in this county.

Quaternary System.—This system is represented in Calhoun county, by the three most common divisions, Alluvium, Loess, and Drift. The alluvial deposits are mainly restricted to the bottom lands which skirt the Illinois and Mississippi rivers on three sides of the county, except between *Cap au Gres* and Milan, where the limestone bluffs jut boldly out to the river's edge. On the eastern side of the county, from the mouth of the Illinois river to Monterey, the bottom lands average nearly three miles in width, but above Monterey they grow narrower, and range from a quarter of a mile to a mile and a half in width. A considerable portion of these bottom lands are prairie, and are the only natural prairie lands in the county. In the northwestern portion of the county, there is a belt of bottom land, lying between Bay creek and the Mississippi river, which is about four miles wide at the county line, but grows narrower to the mouth of Bay creek, where it is not more than half a mile in width. The most of these bottom lands are dry enough for cultivation, and are among the most productive and valuable lands in the county.

Drift.—The drift deposits in this county, probably nowhere exceed forty or fifty feet in thickness, but they cover nearly all the uplands in the county, except at some points along the summit of the bluffs, from whence they have been removed by denudation. They consist of brown clays, some of which are quite free from gravel, with some bluish beds containing gravel and boulders of considerable size, but good exposures of these beds, except a few feet of the upper portion, are seldom to be seen, as there are no railroad grades, or other artificial cuts through this formation in this county. Where the yellow clays of this deposit covers the surface, they form a heavy clay soil, rather hard to work, but quite productive where there is a natural surface drainage.

Loess.—This formation consists of buff, brown, or ash colored, marly clays, or sandy marls, usually quite distinctly stratified. It caps the river bluffs in nearly all parts of the county, and is also frequently found filling the lateral valleys by which the bluffs are intersected. Just below Gilead, the bluffs, as well as the hills, for a mile or more back from the bluffs, are composed mainly or entirely of *Loess*, which is here from fifty to seventy-five feet in thickness. At this point, it appears to occupy the eastern portion of an ancient valley, excavated by some cause in operation before the formation of the existing rivers, but now, in part occupied by them, and also in part, by the alluvial deposits to which they have given origin. The hills around the *Salt Spring*, and between that and the bottom lands on the Mississippi, are composed of Loess. Where these marly deposits are subjected to a leaching process, they contain numerous calcareous concretions, some of which assume fantastic forms like the "clay stones" of the Connecticut valley, but more frequently they assume an irregularly spherical form, and are known by the popular name of "*petrified potatoes.*" Bleached specimens of the living species of land and fresh water shells of the adjacent region are found in this deposit, and it frequently affords the teeth and bones of extinct Mammalia, but we are not aware that any have been found in it, in this vicinity.

Economical Geology.

Building Stone.—No county in the State contains a greater variety, or more abundant supply of excellent building stone than this. First in value and importance, is the Niagara limestone, which outcrops along the river bluffs on the west side of the county, from Hamburg to Gilead, and thence trending back for a mile or two from the river bluffs, it continues southward nearly to *Cap au Gres*, whence it bends abruptly east across the narrow divide between the Illinois and the Mississippi to Monterey. The whole thickness of the formation is exposed here, and from this point it extends northwardly on the east side of the county, appearing occasionally in outcrops at the base of the bluffs, as far north as Farrowton, opposite to Columbiana. At all the outcrops seen between Gilead and Monterey, this limestone is an evenly bedded buff or brown dolomite, very similar to the rock at Joliet and Grafton, and fully equal in quality to the building stone obtained from either of the above named localities. The only drawback to the immediate availability of this valuable building material, is its situation, a mile or more distant from the Illinois river on the east, and about a half mile from the Mississippi, on the west; but this difficulty could be readily overcome, by the construction of a cheap railroad track from the quarries to the river bank. This formation is from fifty to seventy-five feet in thickness in this county, and the whole mass in townships 11 and 12 south, is an evenly bedded buff, or brown magnesian limestone, and equal in quality to any building stone to be found in the State.

In the northern portion of the county, the Burlington limestone outcrops along the river bluffs, and on most of the small streams. It affords a very good building stone, though not equal to that afforded by the Niagara limestone. The upper part of the formation is a coarse, semi-crystaline limestone, that is easily cut, stands exposure well in a dry wall, and is a useful rock for all the ordinary purposes for which a good building stone is required. Along the river bluffs, and on the small streams it can be quarried very cheaply, and will, eventually, come into very general use for farm buildings, fences, etc.

Between Hardin and Monterey, several quarries have been opened in the Hamilton limestone, which affords a very good material for foundation walls, but the rock is much harder to work than that from the Niagara or Burlington beds. On the west side of the county this rock is too thin bedded to be of much value as a building stone, and, locally, becomes quite arenaceous, and passes into a quartzose sandstone.

In the vicinity of *Cap au Gres*, the Trenton group, which is from three hundred and fifty to four hundred feet thick, could be made available for building material, and the magnesian limestone, which constitutes the lowest member of the series, is an evenly bedded rock, and would furnish a building stone nearly, or quite equal to the dolomites of the Niagara group. From the favorable position of its outcrop, near the top of the *Cap au Gres* bluff, extensive quarries could be opened at this point, at a very moderate expense, and the rock could be transferred directly on to lighters or barges, and towed to any point on the river where a good building stone was in demand.

Below the *Cap au Gres* axis, the St. Louis limestone is the prevailing rock, and forms a continuous limestone cliff along the river to the old town site of Milan, the termination of the bluffs on the Mississippi, in this county. This limestone makes a very durable building stone, but is much harder than the magnesian limestones of either the Trenton or Niagara groups. It is, for the most part, a thin bedded, light gray limestone, but contains some layers thick enough for dimension stone, and the outcrops in this county would furnish an inexhaustible supply of building stone of a fair quality.

Limestone for Lime.—The best material for the manufacture of quick lime in this county, is supplied in great abundance by the St. Louis limestone, which may be made available for this purpose at almost any point where it outcrops along the river, for a distance of more than twenty miles. Some beds in this formation, however, are arenaceous, and contain too great a proportion of silicious or argillaceous material, to be readily converted into lime, while others are a nearly pure carbonate of lime in their composition, and make a very pure white lime. The outcrop of this formation for so great a distance along the river, in the most favorable position for carrying on this branch of manufactures, renders this one of the most eligible points on the river for prosecuting this business on a large scale. The kilns could be constructed so near the river, that the manufactured article could be readily transferred on board steamboats, or barges, thereby saving all expense of land transportation; and the overlying coal beds, which outcrop in close proximity to the limestone, would furnish a cheap and abundant supply of fuel; so that the most favorable conditions exist here, apparently, for the prosecution of this business on an extensive scale. In the northern and central portions of the county, the Burlington limestone is the only rock that can be made available for this purpose, except between Gilead and *Cap au Gres*, where the Trenton limestones are found, a portion of which seem to afford a good material for this purpose. None of the limestones of these groups, however, afford as pure a lime as some of the beds of the St. Louis series, nor do they outcrop generally under such favorable conditions, for the manufacture of lime.

Glass Sand.—The St. Peters sandstone, of which nearly one hundred and fifty feet in thickness is exposed at the *Cap au Gres* bluff, in this county, will furnish an excellent white sand for the manufacture of glass, in great abundance. No other rock in the Mississippi valley furnishes a sand for this purpose, equal to that obtained from this formation, and at the point above mentioned, the supply of this material is absolutely inexhaustible, and the outcrop is so situated, that the material could be transferred directly from the quarry on to steamboats, or barges, and cheaply transferred to any point on the river, where it might be desirable to establish glass manufactories. At La Salle, this business is already established, and the material is obtained from an outcrop of this sandstone in that county, and there is no apparent reason why the manuture of glass should not be successfully carried on here as well as there.

Minerals.—Small pieces of the sulphuret of lead, or "galena," have been found in the superficial deposits of this county, as well as in various other portions of the State, and their discovery has led to considerable speculation as to the probability of finding lead mines in this region; but, although the entire thickness of the Trenton group, (the true lead-bearing formation of the Northwest) is well exposed here, we found no indications of its being a mineral-bearing deposit in this portion of the State. On the contrary, it is entirely different, in its lithological characters, from the lead-bearing rocks of the Northwest being here a rather soft, coarse grained, yellowish gray limestone, exhibiting nowhere in this region the magnesian character that every where prevails in the lead producing rocks, of Lower Silurian age. It is probable the few specimens of galena found in this county, have been transported from the northern lead mines by drift agencies, as both galena and native copper are frequently found in the drift deposits in various portions of the State, and under conditions that show that they have no relation with the underlying formations. Even if the specimens of lead ore that are reported to have been found in the vicinity of the outcrop of the Trenton limestone in this county, really came from that formation, they have not indicated the presence of such an amount of lead in the rock formations of this county, as would justify the expectation of their affording productive lead mines. The same agency, by which boulders of granite, sienite, and other metamorphic and igneous rocks, have been transported from localities hundreds of miles to the northward, would also account for the occurrence in the drift material in which they are imbedded, of any other mineral or rock that is known to occur in the direction from which the great mass of the drift material has come.

Iron, both in the form of a carbonate and of a sulphuret, occurs in the Coal Measures in this county. The carbonate is most commonly met with in the form of nodules or "kidney ore," in the shales associated with the coal, while the sulphuret occurs in the coal itself, as well as in the shales, in yellow or silvery gray crystals, and often forming nodular concretions of considerable size. The sulphuret is worthless as an ore of iron, and is only useful when it occurs in large quantities, for the manufacture of copperas and alum, both of which may be obtained from it. The carbonate is a valuable ore for the production of metalic iron, whenever it can be found in sufficient quantity to justify the establishment of a furnace. The shales forming the roof of Williams's coal, are highly ferruginous, and there is about a foot in thickness of impure iron ore between the main coal seam and the thin, four-inch seam above it, at the only locality where we found an exposure of the shales forming the roof of this coal. Nodules of the carbonate of iron were also seen at other points, which had, no doubt, come from the shales of the Coal Measures, but we met with no body of iron ore in this county, where it seemed to be in sufficient quantity to become valuable for the production of iron.

Coal.—Although there is a development of about one hundred and twenty feet in thickness of strata belonging to the Coal Measures, in this county, including the horizon, of at least three seams of coal, only one has yet been found thick enough to pay for working. This seam has been partially opened at several points in the county, but no systematic mining seems to have been attempted, except at Williams's mine, situated in the bluffs of the Mississippi river, about a mile above Fruitland Landing. The coal is here about twenty-six inches thick, of good quality, and apparently quite free from the sulphuret of iron. An analysis of this coal, by Mr. Henry Patten, reported in Norwood's "Analysis of Illinois Coals," gave the following results:

Specific gravity		1.2631
Loss in coking	45.7	
Total weight of coke	54.3	
		100.00
Analysis: Moisture	4.8	
Volatile matters	40.9	
Carbon in coke	49.1	
Ashes (brown)	5.2	
		100.00
Carbon in coal	53.06	

Without a more complete exposure of the strata, and in the absence of fossils, both animal and vegetable, in connection with this coal seam, it is difficult to say exactly where this seam belongs in the general section of the Coal Measures, but from the appearance of the coal, as well as from the stratigraphical position which it occupies, I am inclined to regard it as No 2, or the equivalent of the Murphysboro and Colchester coals. It is not very uncommon to find this seam divided as it is here, and sometimes it is so equally divided that neither division is thick enough to be worked separately. If this conclusion is confirmed, then No. 1 would be represented by the black shale said to have been penetrated at the depth of about fifteen feet below the main seam, and No. 3 would belong about the horizon of the concretionary, gray limestone that lies about sixty-five feet above it. But little has yet been done towards developing the coal in this county, although the mines were opened in the river bluffs at an early day, and have been worked at intervals for years. This seam has only been opened at two or three points, away from the river, where the coal was found outcropping in the ravines by which the Coal Measures are intersected. Coal seams no thicker than this, are worked with profit in many portions of the State, where the market facilities are no better than they are here, where the outcrop is on the bank of the Mississippi, and the coal would all find a ready market without incurring the expense and risk of transportation.

Brine Springs.—On the northwest quarter of section 16, town 11 south, range 2 west, there is a large sulphur spring, slightly impregnated with salt. The water is said to have been a much stronger brine formerly than now, but a boring was made to the depth of 198 feet, which changed the character of the water flowing from the spring, so that it is now a strong sulphur water, but so strongly impregnated with salt as to render it rather unpalatable. This spring flows out from the horizon of the Cincinnati group, but the water probably comes from the Trenton limestone, or else comes up through a crevice in that rock from some old formation, as that limestone was struck in the well at a depth of twenty-two feet. Fine springs of fresh water abound in the central and northern portions of the county, where the Burlington limestone is the prevailing rock.

Soil and Agriculture.—The surface over a large portion of the uplands in this county, is quite broken and hilly, and in some portions the hills are too steep for cultivation, but the soil is excellent, being generally predicated upon the Loess, and as a fruit growing region it is hardly surpassed by any portion of the State. The soil is generally a chocolate colored clay loam, such as we generally find over the regions adjacent to the river bluffs, where it rests upon the Loess. It has a complete surface drainage from the rolling character of the country, and is very productive in all the cereals and fruits of a temperate climate. This county has but recently attracted the attention of horticulturists, and a number of extensive fruit farms have been opened within the past five years. Extensive peach and apple orchards are already in bearing, and show by their healthy appearance and abundant crops of fruit, the complete adaptation of the soil on these uplands to the cultivation of fruit. A good many vineyards have been planted in this county, and have generally produced abundantly, yielding most satisfactory returns for the capital and labor expended.

The bottom lands in this county are exceedingly productive, and yield annually large crops of corn, wheat, oats, barley and grass, and may be fairly ranked among the most valuable and fertile lands in the State. Calhoun county has been entirely under-estimated as to its value as an agricultural region, and when its uplands are planted with orchards and vineyards, and its rich alluvial bottoms are covered with the cereals to which they are adapted, it will compare favorably, in the amount and variety of its annual productions, with the most favored portions of the State.

In closing my report on this county, I desire to express my acknowledgments to Capt. Wm. H. Reed, of Reed's Landing, and his excellent lady, for the cordial hospitality of their pleasant home, which they so kindly extended to me while engaged in prosecuting my examinations in the northern part of this county, and also, in behalf of the State, to acknowledge the receipt of valuable specimens of minerals, fossils and Indian antiquities, contributed by them to the State cabinet. To their little daughter, Miss Eliza Reed, the State collection is also indebted for a beautiful fossil crinoid, found by her in the Burlington limestone, in the vicinity of their residence.

CHAPTER II.

PIKE COUNTY.

Pike county lies between the two great rivers, the Illinois and the Mississippi, and is bounded on the north, by Adams and Brown counties; on the east, by the Illinois river; on the south, by Calhoun county; and on the west, by the Mississippi. It embraces a superficial area of about twenty-one townships, or seven hundred and fifty-six square miles, and the surface is generally rolling, and on the borders of the streams it is quite broken and hilly. A large proportion of the surface, on the upland, was originally heavily timbered, but there are several small prairies in the central and northern portions of the county. It is a well watered county, being intersected by numerous small streams, besides the two large rivers which form its eastern and western boundaries. Among the principal streams in the interior of the county, are McGee's creek, and its tributaries, in the northeastern part; Bay creek, which traverses its central and southern portions; and McDonald's creek, Hadley's creek, and some others of less importance, which intersect the western part, and empty into a bayou, which traverses the bottom lands on the west side of the county, through its whole extent. The valley of the Mississippi is from eight to twelve miles in width, and, as the present river channel is along the western edge of this valley, it leaves a wide belt of bottom lands on the western border of the county, containing an area of about one hundred and sixty square miles, or more than one-fifth of the whole area of the county.

The general level of the uplands may be estimated at from two to three hundred feet above the great water courses, on either side, with no very well defined water shed to determine the courses of the smaller streams. The soil on the timbered lands, is generally a chocolate colored clay loam, becoming lighter colored on the breaks of the streams, and in the vicinity of the river bluffs.

The geological structure of this county is somewhat peculiar, and the strata exposed within its limits comprise the upper part of the Niagara limestone, the whole series of Lower Carboniferous limestones, except the Chester group, and a limited thickness of Coal Measures, with the usual surface deposits of Loess and Drift. No well defined beds of Devonian age were seen in the county, though a little below the southern line, in Calhoun county, we found two or three feet of quartzose sandstone resting upon the Niagara limestone, which, no doubt, belongs to the Hamilton group, and is the most northerly outcrop of this formation known in this part of the State. The green and blue shales, sometimes including a few feet of chocolate brown, or black shale, which immediately overlies the Niagara limestone here, contains no fossils, and shades into the arenaceous beds of the Kinderhook group so completely, that no line of separation can be seen between them. Hence we have included these shales, which have heretofore been referred to the age of the "Black Slate," of Ohio, in the Lower Carboniferous series, and consider them as probably the equivalent of a black shale, that is found in Ohio intercalated in the Waverly sandstone. This, in the absence of the Hamilton limestone, or any lower division of the Devonian system, leaves the Lower Carboniferous beds resting immediately upon the Upper Silurian limestones.

A very decided want of conformability may be observed between the Coal Measures, and the limestones on which they rest in this county. Usually in this portion of the State, if the sequence of strata is complete, the Coal Measures rest upon the upper beds of the St. Louis limestone, but this group is wanting here, except on the northern limits of the county, and the Coal Measures are found resting unconformably on the Keokuk limestones, in the east part of the county, and on the Burlington beds, in the western portion. This peculiar feature in the geology of the county, has resulted from the elevation and subsequent denudation of the strata, anterior to the deposit of the coal.

In addition to the disturbance of the strata, resulting from the *Cap au Gres* axis, described in the report on Calhoun county, which, no doubt, also affected the strata in the southern part of Pike, there is another, though less decided, axis in this county, which, probably, changed the level of the Lower Carboniferous limestones, over nearly the whole extent of the county, and resulted in the subsequent denudation of the strata already alluded to. This axis occurs in the vicinity of Six Mile creek, and its effects are most apparent on the northwest quarter of section 7, township 7 south, range 4 west, where the Niagara limestone rises abruptly from beneath the surface of the bottom lands at the foot of the bluffs, and, dipping north 20° west, at an angle of 7°, rises, in a distance of scarcely more than a hundred yards, so as to form a perpendicular cliff, from forty to fifty feet in hight. There has, evidently, been a dislocation of the strata here, for we find this limestone outcropping along the foot of the bluff, from Rockport down nearly to the point where it rises so suddenly from the river bottoms, and showing above this point no very decided inclination. The elevating force, however, was not sufficient to bring the whole thickness of the group above the surface, although about fifty feet in thickness is exposed. The following section will show the thickness of the formations found in this county, but for reasons already given, they do not always hold the same relative position as in the section given below:

		FEET.
Quarternary deposits (Loess and Drift)		40 to 100
Coal Measures		20 " 60
Lower Carboniferous	St. Louis Limestones	00 30
	Keokuk group	100 " 125
	Burlington limestone	150 " 200
	Kinderkook group	100 " 120
Niagara limestone		00 50

The Niagara limestone is only found in the southwest part of the county, where its main outcrop is at the base of the bluffs, between Rockport and the south line of the county, and on Six Mile creek, for a short distance up that stream. Where the rock first appears, the upper portion is a rather thin bedded, rough, gray limestone, becoming more massive below, and on Six Mile creek, it is partly a regular bedded buff or brown dolomite, and presents the usual characters of this formation at other localities. It contains a few fossils at the outcrop in the vicinity of Pleasant Hill, among which we obtained fragments of *Trilobites*, a few fossil shells, too imperfect for determination, and a single specimen of *Halysites catenulatus*.

At Mr. Wells's place, on the northwest quarter of section 17, township 7 south, range 4 west, the buff colored magnesian beds of this group are exposed about ten feet in thickness, and the rock has been quarried for general use as a building stone in the neighborhood. The beds appear to dip here in an opposite direction from those at the point where the rock rises so suddenly from beneath the surface of the bottom lands, at the foot of the bluffs, the direction being to the south 20° east, and the angle about 6°. On the southeast quarter of section 8, in the same township, there is an exposure of about twenty-two feet of this limestone, the lower ten feet being a gray, even bedded limestone, and the upper twelve feet a buff colored magnesian rock, closely resembling the rock from the Grafton quarries. It is the prevailing rock at Pleasant Hill, and forms a limestone bench about thirty feet in hight, above the road, at the base of the bluffs. Two miles north of Pleasant Hill, on a branch of Six Mile creek, the upper part of this limestone is exposed in the bed of the creek, dipping north 30° west, about 2°. Only about six feet in thickness is exposed here, and the rock is a regular bedded, brown magnesian limestone. This seemed to be about the most easterly outcrop of this formation, and it is here overlaid by the shales of the Kinderhook group. From this point southwestward, to the Calhoun county line, occasional outcrops of this limestone may be seen along the base of the bluffs, and its entire outcrop in this county is restricted to the vicinity of the river bluffs between Rockport and the south line of the county.

Kinderhook Group.—One of the best exposures of this group in this county, is at the point of the bluff, just above the village of Kinderhook, from whence it has received its name. The following is the section at this point:

	FEET.
Loess capping the bluff	20
Burlington limestone	15
Thin bedded, fine grained limestone	6
Thin bedded sandstone, and sandy shales	36
Argillaceous and sandy shales, partly hidden	40

The three lower beds of the above section belong to this group, and there are some twenty feet or more of still lower beds, which do not appear above the surface here. The thin bedded, fine grained limestone, which lies at the top of the series here, resembles the fragmentary limestone at Burlington, Iowa, which, at that locality, contains *Chonetes Fischeri*, *Rhynchonella pustulosa*, and *Spirifer biforatus*, but no fossils were found in it here. The thin bedded sandstones below this, however, abound in fossil shells, belonging to the genera *Aviculopecten*, *Spirifer*, *Orthis, and Productus*, mostly identical with those from the gritstones at Burlington, which belong to the same horizon. The Argillaceous shales at the base of this group, have afforded no fossils as yet from any of the localities examined in this county. From Kinderhook southward, along the bluffs on the west side of the county, this group is more or less exposed below the Burlington limestone, which forms the upper escarpment, and at Rockport, nearly the whole of the group may be seen, forming the following section:

	FEET.
Loess capping the bluff	20 to 30
Arinaceous limestone and shale	16
Unexposed strata	20
Green and blue clay shales	30
Covered slope to the level of the road	32

On our first visit to this county, in 1853, we found at this point a brecciated oolitic rock, about three feet thick, which receives a high polish and makes a beautiful marble. At a more recent visit, we did not find it exposed, and it is probably included in the twenty feet of unexposed strata, below the arenaceous beds near the top of this section. This arenaceous limestone contains a few fossils, among which are *Spirifer Marionensis, S. hirtus, Productus pyxidatus, P. arcuatus, Rynchonella Missouriensis, and Chonetes geniculata.* About two miles below Atlas, the Burlington limestone caps the bluff, and we find the Kinderhook group outcropping below it, affording the following section:

	FEET.
Burlington limestone	12
Magnesian limestone	8
Unexposed	18

Sandy shales	38
Blue clay shales	44
Covered slope to the level of the road	27

Probably about fifteen feet in thickness at the base of this section, is occupied by the Niagara limestone, leaving 120 feet as the aggregate thickness of the Kinderhook group at this point. The sections above given will illustrate the general character of this group, as it appears in this county, where it is composed mainly of sandy and argillaceous shales, with some thin beds of limestone. Its outcrop is confined to the river bluffs, and the lower courses of the small streams that intersect them. Commencing on the west side of the county at the north line, we find from forty to fifty feet of these shales outcropping below the Burlington limestone, which forms the upper escarpment of the bluffs, and thence southward they gradually rise until, at Rockport, we find the whole thickness of the group in partial exposures above the level of the bottom road. In the vicinity of Pleasant Hill, the bluffs are composed of Niagara limestone, overlaid by Loess and Drift, and the outcrop of the Kinderhook is found further back on Six Mile creek and on the branches of Bay creek. On Cold Run, about a mile above the point where it enters Bay creek, the green and blue shales of the Kinderhook group are well exposed, giving a measured section 31 feet in thickness. These are overlaid by sandy shales, that are but partially exposed, but containing a few feet in thickness of fine grained, evenly bedded sandstone, that has come into general use in the neighborhood for constructing chimneys, building foundation walls, etc. It is said to be a very refractory stone, that is scarcely affected by the action of fire, and also possesses a fine, sharp grit, which makes it a useful material for grindstones, whetstones, etc., for which it has been very generally used in this vicinity. The bed, however, is only from three to four feet in thickness at the point where we found it exposed, which was about three-quarters of a mile east of Mr. J. G. Sitton's farm.* These beds, and the blue and green shales which underlie them, will be found outcropping on all the tributaries of Bay creek, in this vicinity, as well as on the main creek.

Crossing the county to the Illinois river bluffs, near the south line, we find these beds forming the lower portion of the bluff, and well exposed on the lower course of Bee creek, and in the bed of the creek at the mill, there is a partial outcrop of the black shale, which sometimes forms the lowest strata of the group. The beds are not fully exposed here, but in ascending the stream, the argillaceous and sandy shales are occasionally seen in partial exposures, showing that the group retains essentially the same characters on this side of the county as on the other. From this point northward, these shales appear in occasional outcrops along the bluffs, to the vicinity of Bedford, where they dip below the surface and are seen no more. As this group does not form the bed rock over any considerable surface area in this county, it fails to impart any of the peculiar topographical features to the surface here, which usually characterize it where it is well developed, with no overlying limestone to modify its influence on the topography of the country. Then, it almost invariably forms a broken and hilly region, so marked in its character that the extent of its outcrop may be very accurately defined, from the peculiar topographical features of the surface alone. But almost everywhere in this county, where the group is exposed, the Burlington limestone overlies it, and therefore determines the topographical features of the region also underlaid by the shales and gritstones of this group.

---

*A rock exactly like this, from Marshalltown, Iowa, and from the same geological horizon, receives a high polish, and is used for tables and various other purposes, as an ornamental stone, and the rock from the above named locality, in Pike county, seems to be equally as well adapted for this purpose.

Burlington Limestone.—This limestone forms the bed rock over fully one-half of the entire surface of the uplands in this county, and its outcrop, in a general way, may be thus described: Commencing on the western side of the north line of the county, it forms a belt, from five to ten miles in width, the western border of which is defined by the river bluffs, and extending thence to the southern line of the county, forming the bed rock over all that part of the county lying south of Pittsfield, and from that point northward to Griggsville Landing, and south to the Calhoun county line, underlying all the highlands in that portion of the county south of Pittsfield, except a very limited area in the vicinity of Pleasant Hill, where the Niagara limestone forms the surface rock. Its thickness ranges from one hundred and fifty to two hundred feet, but usually not more than fifty or one hundred feet can be seen at a single outcrop. The best exposures of this rock are to be seen in the bluffs of the Illinois and the Mississippi, and on some of the principal creeks in the western and southern portions of the county. The rock is a rather coarse grained, gray limestone, with intercalations of buff or brown layers, and is largely composed of the fossilized remains of the *Crinoidea* and *Mollusca*, that swarmed in countless myriads in the old carboniferous ocean, during the formation of this limestone. It is the *Crinoidal* and *Encrinital* limestone of some of the old observers, and it was so designated in consequence of its being almost entirely composed, at some localities, of the remains of these radiated forms of animal life. Indeed, the main portion of the rock consists of the calcareous plates and joints of *crinoids*, with barely enough mineral matter to cement the organic remains together.

In the Mississippi bluff, near the north line of the county, there is from forty to fifty feet of the lower portion of this limestone exposed, forming the upper escarpment of the bluff. These lower beds consist of alternations of gray and brown limestone, usually in regular and tolerably thick beds, and contain *Orthis Michelini*, *Euomphalus latus*, *Spirifer Grimesi*, and *S imbrex*. The pygidium of a beautiful Trilobite was found in these lower beds, near Kinderhook, to which the name, *Phillipsia tuberculata* has been given. From the north line of the county, southward, to a point about ten miles below Atlas, this limestone forms the upper portion of the bluff at most of the points examined, and from thence it trends eastwardly across Six Mile creek to the waters of Bay creek, and caps the bluffs on the eastern side of that creek, at the south line of the county. It outcrops on all the small streams south of Pittsfield, and is extensively quarried on Big Blue creek, about four miles southeast of there, for building stone for the supply of the town and adjacent country.

On the eastern side of the county, the most northerly outcrop of this limestone is in the vicinity of Griggsville Landing, where the cherty beds of the upper division of this rock are exposed at the base of the bluff. The outcrop is here about fifty feet in thickness, and so far as it is exposed in the quarries opened, the rock consists of alternations of thin bedded, gray limestones, with seams of chert. The cherty material is also disseminated through the limestone strata, in nodules and concretionary masses of considerable size. From this point to Montezuma, this limestone forms a low bluff, seldom rising more than fifty feet above the level of the adjacent bottom lands. At Montezuma, where several quarries have been opened in this rock, the beds exposed are about fifty feet in thickness, the lower ten feet being a massive gray limestone, comparatively free from chert, while the remaining portion consists of thin bedded, brownish gray crinoidal limestone, with considerable cherty material in seams and nodules. Fossils are quite abundant, and among others not yet determined, the following species were collected here: *Spirifer striatus*, *S. Grimesi*, *S. imbrex*, *Productus punctatus*, *P. semireticulatus*, *Strophomena analoga*, *Orthis Michilini*, *Euomphalus latus*, *Lyropora retrorsa*, *Evactinopora grandis*, *E. sexradiata*, *Agaricocrinus planoconvexa*, *Platycrinus planus*, and several species of *Actinocrinus*. From Montezuma to Bedford, this limestone rises rapidly, and the bluffs immediately north of Bedford are at least one hundred and fifty feet in hight, and consist mainly of this limestone, capped with a few feet of Loess. Just below Bedford, the underlying shales appear at the base of the bluffs, and from thence to the south line of the county, the bluffs range from one hundred and fifty to two hundred feet, or more, in hight, the upper escarpment consisting of a hundred feet, or more, in thickness, of Burlington limestone, while the talus below covers the shaly beds of the Kinderhook group.

On Bay creek, this limestone is well exposed, and forms the main portion of the bluffs along this stream, from the vicinity of Pittsfield to the point where it intersects the river bluffs, about two miles above the Calhoun county line. It is the most important of all the limestones exposed in this county, whether considered in reference to the extent of surface over which it outcrops, or the amount and value of the economical material which it affords. Although as a building stone it is not quite equal to the magnesian beds of the Niagara group, which outcrop in the vicinity of Pleasant Hill, it is, nevertheless, a very durable stone, and may be made available for all the ordinary uses for which such a material is required, and it is easily accessible over about one-half of the whole area of the county.

Keokuk Group.—This group, which immediately succeeds the Burlington limestone in the ascending order, outcrops over a considerable area in the northern and northeastern parts of the county, where it is frequently found immediately beneath the Coal Measures, the St. Louis group, which should properly intervene, having been removed by denudation, anterior to the coal epoch. It consists of light gray and bluish gray, cherty limestones at the base, which closely resemble the upper beds of the Burlington limestone in their lithological characters, so that it would sometimes be difficult to define the line of separation between them, except for the fossils, which always serve to distinguish them. Some of the limestone strata are quite as *crinoidal* in their structure as the Burlington limestone, but they are usually more of a bluish gray in color, and may therefore be readily distinguished, even in hand specimens, from the underlying formation. There is usually a series of cherty beds, from ten to thirty feet in thickness, separating the main limestones of these two groups, which may properly be considered beds of passage from one limestone to the other. The upper division of this group consists of calcareo-argillaceous shales and thin bedded limestones, containing geodes lined with crystalized quartz, chalcedony, calcite, dolomite and sometimes, but more rarely, with crystals of zinc blende and iron pyrites, the latter usually in minute crystals implanted on quartz. This division may be seen a mile and a-half southeast of Griggsville, and, where it first appears beneath the Coal Measures which rest upon it here, the geodes are found embedded in a ferruginous sandstone, that perhaps represents the conglomerate, which usually lies at the base of the Coal Measures. A similar occurrence was observed at Moore's coal bank, in Scott county, as has been mentioned in the report on that county. This indicates some erosive action, anterior to or during the formation of this conglomerate, by which the shales in which the geodes were originally embedded were swept away, and the geodes were covered and enclosed in sand, which subsequently hardened into a conglomerate.

The shales and shaly limestones of the geodiferous division of this group, are exposed in the vicinity of Perry Springs, and outcrop on the tributaries of McGee's creek, in that vicinity. The springs flow out of these shaly limestones, and probably derive the small amount of mineral matters which the waters contain, from these beds. On McGee's creek, at Chambersburg, the limestones of this group form the bed of the creek, and the overlying shales form the main portion of the bluffs on the creek, throughout its course in this county.

The limestones which constitute the lower division of this group, occupy the lower portion of the river bluff, about half a mile above Griggsville Landing, and from thence to Chambersburg. Their entire thickness probably does not exceed sixty feet, and at some points the beds are quite massive, and comparatively free from chert, and form an excellent building stone. This is the character of the rock at some points on the south forth of McGee's creek, between Perry and Griggsville.

In the northwest part of the county this limestone is exposed on Hadley's creek, and, in the vicinity of Huntley's coal bank, where the coal abuts directly upon it, we found some of the characteristic fossils of this formation, among which were *Spirifer Keokuk*, *S. neglectus*, and some teeth of fossil fishes. Fossils were not found very abundant at any of the localities where we found this limestone exposed, and as but few quarries have been opened in it, there is but a limited field for the collector among the outcrops of this limestone in this county. At Perry Springs we obtained two specimens of *Agaricocrinus Americanus*, and one of *Archimedes Owenana*.. The same species also occur in the thin bedded limestones in the bed of the creek at Chambersburg.

St. Louis Group.—We saw no indications of the presence of this group any where in the county, except on the breaks of McGee's creek, in the northeast part of the county, and on the south fork of the same creek in the vicinity of Perry. The beds exposed here consist of brown magnesian limestone and shales, and range from twenty to thirty feet in thickness. One mile and a-half northwest of Perry, quarries have been opened in the brown magnesian limestone of this group, which is there about eighteen to twenty feet thick, and directly overlies the geodiferous shales of the Keokuk group. About three miles north of Perry Springs, and near the north line of the county, these magnesian beds are also exposed, and are overlaid by some shaly beds, the whole attaining a thickness of about twenty feet. No exposure of the gray concretionary limestone, which usually forms the upper member of the group, was met with in this county.

Coal Measures.—The coal formation occupies but a limited area in the central and northern portions of this county, underlying the whole of town 4 south, range 4 west, and a portion only of the four surrounding townships. The entire thickness of the formation, as it appears in this county, probably does not exceed sixty feet. The following are the principal points where coal has been dug in this county:

Huntley's old bank, on the northwest quarter of section 15, town 4 south, range 5 west. Coal sixteen to twenty-four inches thick, overlaid by about six inches of black shale.

Huntley's new bank, on the northwest quarter of section 10, town 4 south, range 5 west. The coal is here about six feet thick, with a parting of clay shale in the middle, about two inches in thickness. The coal in the upper part of this seam is rather soft, and contains considerable bisulphuret of iron. The lower division affords a harder and better coal, and rests upon a gray fire clay, two feet or more in thickness. Two or three hundred yards northeast of this opening, a coal scam outcrops at about the same level with this, which is only about eighteen inches in thickness, and is overlaid by a blue clay shale, containing large septaria. This clay shale is apparently quite similar to that which forms the roof at Huntley's mine, and it is probable that the greatly increased thickness of the coal at the point where it is now worked, is due to some local cause, and perhaps to the meeting of two seams, which are only separated by the parting of clay shale, coming together in a pocket or depression in the limestone. The coal here abuts directly upon the Keokuk limestone, which outcrops within a few feet of the coal, and in the bed and bluffs of the creek below it. It is not probable that this thickness of coal strata will be found extending over any considerable area of surface, as the cause which has produced it is most probably entirely local, for no other outcrop of coal is known, either in this or the adjoining counties, where the seams range above two feet, or thirty inches at most, in thickness. Three miles east of Barry, coal has been dug, on a small branch south of the Philadelphia road, and a mile further south, on the north fork of the creek which intersects the river bluffs near New Canton, there is a ble clay shale, from twenty-five to thirty feet thick, exposed along the creek, which contains *septaria* and *tuten-mergel*, and closely resembles the shale over the coal at Huntley's mine. From this point, the western boundary of the Coal Measures trends southeastwardly to Houseworth's coal bank, two miles and a-half northwest of Pittsfield. This mine is on the northeast quarter of section 16, town 5 south, range 4 west, coal about eighteen inches thick, overlaid by about three feet of dark blue shale passing upward into sandy shale, of which about ten feet in thickness was seen above the coal. The coal seam is variable in its thickness here, and ranges from sixteen to twenty-two inches, but at Mr. Harshman's place, a mile north, it is about two feet thick. An analysis of Houseworth's coal, by Mr. Henry Pratten, as reported in Norwood's "Analysis of Illinois Coals," gave the following result:

Specific gravity	1.2203	
Loss in coking	49.5	
Total weight of coke	50.5	
		100.00
Analysis: Moisture	5.0	
Volatile matters	44.5	
Carbon in coke	45.5	
Ashes (white)	5.0	
		100.00
Carbon in coal	53.2	

Four miles west of Griggsville, on the northeast quarter of section 13, town 4 south, range 4 west, coal has been found on Mr. Dunham's place. The coal is from fourteen to twenty inches thick, and is overlaid by about two feet of fossiliferous black shale. Also, on the southeast quarter of section 11, in the same township, the same seam is exposed, and averages about eighteen inches in thickness, and is overlaid by black shale, enclosing nodules of bisulphuret of iron with fossil shells. This coal outcrops at several localities, in the ravines along the road between Griggsville and Salem, and also between Salem and New Philadelphia.

A half mile south of Griggsville, coal has been worked on Mr. Parker's land. The seam varies in thickness, from eighteen to twenty-four inches, and is overlaid by blue shale. Three-quarters of a mile east of this point, the shales and geodes of the upper part of the Keokuk group outcrop along the same creek on which the coal is found, and half a mile south of Houseworth's coal, the Keokuk limestone was seen, and this seems to be the formation on which the Coal Measures rest, in the central and northern portions of the county, except at the outcrops east and southeast of Barry, where they appear to overlie the Burlington limestone.

On Mr. Lazarus Ross's place, a mile and a half northwest of Perry Springs, some indications of coal may be seen in the bluffs of the middle fork of McGee's creek. Partial outcroppings of black and dark blue shales appear here, but so intermingled with drift clays, by the slipping of the beds, that it is difficult to say whether the shales were in *situ*, or had been moved by drift agencies. Some attempts have been made here to find coal, but without success.

In the southeast part of the county we found an outcrop of the Conglomerate, which usually forms the base of the Coal Measures, overlying the Burlington Limestone on Mr. Ch's Meisenbach's place, on the northwest quarter of section 30, township 7 south, range 2 west. About ten feet in thickness of the sandstone was exposed, where there had been an old quarry, and the whole thickness of the bed at this point, is probably not less than fifteen or twenty feet. This sandstone also outcrops on the adjoining farm, owned by Mr. Jordan. This is probably an outlier of sandstone that was originally deposited in a depression of the limestone, where it has been protected from erosion, while the surrounding strata have been removed by denuding forces.

From the outcrops of coal already mentioned in this county, it will be seen that the coal is generally too thin to be profitably mined, except where it can be done in open trenches by throwing off the overlying material. Coal cannot be profitably mined in a regular way, either by tunnel or shaft, where the seam averages less than two feet in thickness, and as the seams in this county are usually less than that, they are of little value unless so situated as to be easily worked by "stripping." The seam at Mr. Huntley's, near the north line of the county is, however, an exception, and may be worked to good advantage by any of the ordinary modes of mining. It is probable, however, from the general development of the coal, both in Pike and Adams counties, that the unusual thickness of the seam or seams, at this point, is a merely local phenomenon, and will be found to extend over only a small surface area. Local thickenings of this kind are not uncommon, and are denominated "pockets" by the miners, the coal sometimes thickening to twelve or fourteen feet, and yet covering only an acre or two of surface, thinning out entirely in a few rods in either direction.

Quaternary System.—A broad belt of alluvial bottom lands, from six to twelve miles in width, skirts the western border of this county, through its whole extent from north to south. The soil on these lands is exceedingly fertile, and where they are elevated above the annual overflow of the river, they comprise some of the most valuable and productive lands in the county. Belts of heavily timbered lands skirt the small streams that intersect these alluvial bottoms, and also the eastern bank of the Mississippi river, through the whole extent of the county, from north to south, but a large portion of these lands were originally prairie, and have been more recently transformed into highly cultivated farms. But little is known of the character of these alluvial beds below the depth of ten or twelve feet, this much only being exposed in the channels of the streams by which they are intersected, but if we could penetrate down to the solid rock bottom, we should most probably find formations which do not appear any where in this region above the surface. That the broad valley of the Mississippi, and other western streams, was formed long anterior to the existence of the rivers which now occupy them, admits of no question, for at many points we find this valley partially filled with beds of drift clay and gravel, exactly like that which covers the adjacent highlands, showing that the formation of the valley antedates the Drift period, but whether these vallies existed during the Tertiary age, or the age preceding the Drift, is a point not yet fully settled, though some facts have been observed which lead to that conclusion. If we could see a complete exposure of the beds underlying these alluvial bottoms, down to the solid rock on which they rest, it is quite probable that evidence might be obtained that would help to determine this interesting question.

So far as these alluvial deposits can be determined by the natural exposures in the banks of the streams, they consist of alternations of clay, sand and loam, in quite regular strata, but of variable thickness. On the east side of the county, there is very little bottom land from the south line of the county to the northern part of township 4 south, range 2 west, where it begins to widen, and from that point to the north line of the county, the bottoms along the Illinois river range from two to five miles in width. These bottom lands, however, are not so much elevated as those on the west side of the county, and are generally too low and wet for cultivation. A portion of them are heavily timbered with cottonwood, sycamore, soft maple, elm, ash, hackberry, honey locust, linden, black walnut, water oak, hickory, etc.

Loess.—The river bluffs on both sides of the county, are capped with this formation, which ranges in thickness from ten to sixty feet or more. It always overlies the Drift, where both are present, and hence is of more recent origin, and it also differs in its character and appearance from the Drift deposits. It generally consists of buff or brown marly clays and sands, usually stratified, and often so coherent as to remain in vertical walls twenty or thirty feet in hight, when an artificial cut is made through it. On analysis, it generally affords from seventy five to eighty per cent. of silica, from ten to fifteen per cent. of alumina and peroxide of iron, from three to four per cent. of lime, and one to two per cent. of magnesia. Its greatest thickness is usually on the top of the river bluffs, and in the lateral valleys immediately adjacent to them, and from thence it thins out generally towards the summit level of the interior. In the vicinity of Chambersburg, in the northeast part of this county, the Loess forms the main portion of the bluff, so far as can be seen, and appears to be at least sixty or seventy feet in thickness. The timbered lands adjacent to the bluffs on both sides of the county, are usually underlaid by this formation, and it furnishes a light porous subsoil, which is admirably adapted to the growth of fruit trees, vines and small fruits. At many localities, it contains a variety of fossil shells, which present the usual bleached and water-worn appearance of the dead shells of our ponds and bayous. It also affords a variety of calcareous concretions, which assume many imitative forms, some of them resembling potatoes, and others taking discoidal forms like the "clay stones" in the drift clays of New England. It gives origin to the bald knobs so frequently met with along the river bluffs, and is often rounded into natural mounds, which have been very generally used by the Indians as burial places for the dead. The bones of extinct mammalia are often found in the marly beds of this formation, and are associated with both land and fresh water shells, which would indicate this to be a sedementary accumulation in a fresh water lake, or rather series of lakes, into which the land shells and bones of land animals were carried by rivers, or smaller streams of running water. Bones of the Mammoth, the Mastodon, and the Casteroides, or fossil beaver, have been found in this formation in this State, and also the flint arrows and other implements of primeval man.

Drift.—The lowest division of the Quaternary system comprises a series of variously colored clays, containing gravel and boulders, to which the term "Drift" is usually applied, because the materials of which it is composed have been transported, or drifted, to the region they now occupy. This appears to have been accomplished, mainly by currents trending southwardly, for we find in the drift deposits, water-worn boulders of all the rock formations, outcropping over an area of four or five hundred miles to the northward, as far, at least, as the northern shores of the great lakes, from whence the granitic, sienitic, and igneous boulders have come. Over a large portion of this county, especially adjacent to the river bluffs on either side of the county, the drift is rarely exposed, from the thickness of the overlying beds of Loess, which covers it to the depth of from ten to fifty feet. In the central portions, it is more accessible, and is penetrated in digging wells, and all other excavations below the subsoil of the surface. Heavy beds of drift material cover the surface, overlying the Keokuk limestones in the vicinity of Perry, and extend southward through the central portions of the county, with a variable thickness ranging from twenty to forty feet, or more. They are composed mainly of brown and yellow gravelly clays, which usually become bluish gray towards the bottom, and enclose rounded boulders of metamorphic and igneous rocks, as well as those derived from the limestones and sandstones that constitute the paleozoic strata of our own and the adjacent States. Towards the river bluffs, the drift deposits are not so thick, and at some points along the summit of the bluffs, they are wanting altogether, and the Loess rests directly upon the limestones. At many points in the State, beds of stratified sand and clay are found beneath the Drift, overlaid by the ancient soil which covered the surface anterior to the Drift period, but no shafts have been sunk, or other excavations made, so far as I am aware, in this county, deep enough to determine whether these Post Tertiary beds exist here. It is quite probable they will be found in the central and northern portions of the county, as they are known to exist in the adjoining county on the north. At the base of the Drift deposits, in the vicinity of Barry, there is a bed of clean, yellow flint gravel, that is partly cemented by the oxide of iron into a ferruginous conglomerate, like that on the Ohio river, in Massac county, which has been considered as of Tertiary age. It was scarcely more than a foot in thickness where we saw it exposed.

Economical Geology.

Building Stone.—Pike county has an abundant supply of excellent building stone, which may be obtained from all the principal limestones that outcrop within its borders. The Niagara limestone, in the vicinity of Pleasant Hill, furnishes a buff magnesian rock, in very regular beds, fully equal in quality to that afforded by the same beds at Grafton and Joliet. The upper ten or twelve feet of this formation is of this character, while the lower strata are of a gray color, contain less magnesia in their composition, and, although a durable stone, are not as easily worked as the rock from the overlying beds. A portion of the material for the construction of the new public school building at Pittsfield, which is one of the finest in the State, and reflects the highest credit on the people of that town, was brought from Joliet, while the same bed of limestone, affording a material in every way equal to that from Joliet, outcrops within ten miles of Pittsfield. A want of the knowledge of this single fact, has probably cost the citizens of Pike county far more than their proportion of the entire cost of the Geological Survey of the State.

The Burlington limestone, which outcrops over a wide area in this county, will furnish an unlimited supply of excellent building stone. The thickness of this formation is probably not less than one hundred and fifty feet, and nearly the whole of it may be made available, either as a building stone, or, if the beds are full of flinty material, as is locally the case, as an excellent macadamizing material for the construction of turnpike or common roads. The rock is usually a light gray or brown sub-crystalline limestone, and where free from flint or chert, is easily dressed and stands exposure well, being but slightly affected by atmospheric action. In the vicinity of Montezuma, the lower ten feet of the limestone exposed in the bluffs at that point, is a massive gray rock, quite free from chert, and this lower division would afford dimension stone of any desirable size. Similar beds are exposed on Big Blue creek, four miles southeast of Pittsfield, where most of the rock required for use in the town is obtained. There is about forty feet in thickness of the rock exposed here, mostly in massive beds, from two to four feet thick. On the west side of the county, it forms an almost continuous outcrop, from ten to forty feet in thickness, along the river bluffs, from the north line of the county to a point about two miles below Atlas, where it is cut off by the elevation of the Upper Silurian strata, and on the east side it forms a continuous outcrop in the bluffs of the Illinois, from the vicinity of Griggsville Landing, to the south line of the county. It also outcrops extensively on Bay creek, and all the smaller streams in the southern part of the county. This renders it easily accessible to all that part of the county south of Pittsfield, as well as the region adjacent to the river bluffs.

The lower portion of the Keokuk limestone, which immediately overlies the Burlington, is quite similar in character and appearance to the latter rock, and furnishes a building stone fully equal to that afforded by the Burlington limestone. It is usually rather free from chert at the principal points, where we found it well exposed, and excellent building stone is obtained at the quarries two miles north of Griggsville, on the south fork of McGee's creek. It differs from the Burlington rock more in color than in texture, being usually more inclined to a bluish gray, but is semi-crystalline and highly crinoidal, being almost entirely composed of the joints and plates of *crinoids*, cemented together by a calcareous paste. The bands of shale, or marly clay, which are usually found separating the strata of limestone at Nauvoo, Keokuk, and other northern localities, were not observed here, and hence in its outcrop it is not readily distinguished from the Burlington rock, except by a critical examination of the fossils which it contains.

The St. Louis group, although quite limited in this county, both in its development and outcrop, furnishes some excellent building stone. About a mile and a-half northwest of Perry, there is an outcrop of about eighteen feet in thickness of massive, brown, magnesian limestone, that, for culverts, bridge abutments and foundation walls, especially where the rock is to be subjected to the combined action of frost and moisture, has no superior in the State. It contains considerable iron, which oxydizes freely, and gives to the surface a rusty brown color, which unfits it for use in the outside walls of fine buildings, where a pleasing exterior is desirable, but for all other uses it is a valuable and durable stone. This limestone was also met with just on the north line of the county, immediately north of Perry Springs, where a portion of the bed presented the same general character as at the locality above mentioned. It was only seen in the extreme northern portion of the county, in township 3 south, ranges 2 and 3 west.

Coal.—The coal deposits of this county are limited in their extent, and at all the points where coal has been found, with a single exception, the seams have proved to be too thin to be worked, except by the process of "stripping" or throwing off the overlying material, and working out the coal in open trenches. There are probably a good many points in the county where this may be done to advantage, in the valleys of the small streams where the coal seams outcrop, but the completion of the railroad from Naples to Hannibal will give access to the heavy coal seams east of the Illinois river, and thus supply the demands of this county for coal, at cheaper rates than could be done from the limited deposits within the county. At Huntley's mine, in the northwestern part of the county, the coal is six feet thick, and is worked by tunneling into the outcrop, for the supply of the adjacent region, but for reasons given on a preceding page, we are inclined to regard this as a local deposit, that will soon be exhausted. With this single exception, there is no coal known in this county that averages two feet in thickness over any considerable area, and the general range is only from sixteen to twenty inches.

Minerals.—No ore of any kind, except iron, was met with in the county. Carbonate of iron, as well as the bi-sulphuret, is found in the Coal Measures, and the former is a valuable ore for the production of iron, where it is sufficiently abundant, but no deposits of these ores were found in the county of sufficient thickness to justify the expenditure of capital or labor in attempts to develop them.

Limestones for lime.—The best and purest limestone for the manufacture of quick lime, will be found in the Keokuk and Burlington limestones. The upper or concretionary member of the St. Louis group, which is generally preferred for this purpose, was not met with in this county, and if found at all, would be too local in its development to supply any considerable portion of the county, but the limestones above named, one or both of them, are easily accessible at most points in the county, and when the rock is carefully selected, they afford a very good material for this purpose.

Hydraulic limestone.—Some of the upper beds of the Kinderhook group, in the vicinity of Mr. Churchill's place, just above the village of Kinderhook, presents the usual appearance of a hydraulic limestone, and a specimen of the rock analysed by the late Mr. Henry Pratten, gave the following results:

Water	2.82
Silica	7.00
Alumina	0.77
Carbonate of Lime	68.15
Peroxide of iron	0.77
Protoxide of manganese	2.11
Carbonate of magnesia	18.55

This analysis would seem to indicate too large a per cent. of carbonate of lime, and too small a proportion of the silicates of alumina and iron, to form a good cement rock, but further tests might show that the rock was well adapted for this purpose.

Clay and sand.—The fire clay which usually underlies the coal, if tolerably free from lime, is valuable for the manufacture of fire brick and common pottery, and where the coal seams are thin, it can be mined with the coal to good advantage. The brown clays of the Drift furnish an abundant material for the manufacture of common brick, and sand is abundant in the valleys of the streams. The Loess often affords these materials in just the right proportion for the use of the brick machine.

Marble.—The bed of oolitic conglomerate, already mentioned as occurring in the Kinderhook group at Rockport, receives a fine polish and makes a beautiful variegated marble. The bed, however, is only about three or four feet in thickness, and can not be easily worked where it outcrops in the bluffs, on account of the thickness of the beds which overlie it, but it may be found in some of the lateral vallies in that vicinity, where it could be quarried at less expense. Some of the sub-crystalline beds of the Burlington limestone receive a high polish, and make a fine ornamental stone.

Mineral Springs.—Perry Springs are situated about two and a-half miles southeast of the town of Perry, on a small branch of one of the tributaries of McGee's creek. The springs, three in number, issue from the upper part of the Keokuk limestone, which underlies the valley, and outcrops along the bluffs of the creek below the springs. They are about a hundred yards apart, and the upper one is called the Sulphur Spring, the middle one the Magnesian, and the lower the Iron Spring. The middle one is the most used, and affords the largest supply of water. They preserve a nearly equal temperature throughout the year, of about 48 to 50° Fahrenheit. An analysis of the waters of these springs, by Mr. Henry Engelmann, as reported to the proprietors, Messrs. Watson & Divelbiss, gave the following amount of mineral matter, in grains, to each gallon of water:

	No. 1, or middle spring.	No. 2, or upper spring.	No. 3, or lower spring.
Bi-carbonate of lime	15.89	19.75	19.66
Bi-carbonate of magnesia	17.01	14.81	10.49
Bi-carbonate of iron	0.55	0.60	0.27
Silicate of alumina	0.00	0.00	0.27
Silicate of potassa and soda	2.64	2.28	3.45
Silicate of sodium	0.12	0.38	0.58
Sulphate of soda	0.44	1.10	1.49
Carbonate of potassa	1.59	1.45	1.26
	38.24	40.37	37.47

These Springs are situated in a beautiful valley, surrounded by wooded hills, and afford a pleasant retreat for the invalid, and those desiring a temporary respite from the dust and turmoils of city life. They probably derive their mineral ingredients from the geodiferous shales of the Keokuk group, and a similar spring issues from about the same horizon at Warsaw, in Hancock county.

Soil and Timber.—The greater portion of the uplands in this county, were originally covered with a heavy growth of excellent timber, but there are a few small prairies, seldom more than two or three miles in width, interspersed over its surface, and occupying the most level portions of its area. The surface of the county is generally rolling, and in the vicinity of the streams, becomes quite broken and hilly. The timber consists of white, red, and black oak, pig-nut and shell-bark hickory, black walnut, elm, linden, wild cherry, honey locust, sugar maple, sassafras, etc. The soil on the prairies and more level timbered lands, is a dark, chocolate colored clay loam, very productive, and yields annually large crops of grass, and all the cereals adapted to the climate. On the more broken lands along the streams, the soil is lighter colored, and less productive, but well adapted to the growth of wheat, clover, and especially of fruit. The freshly cleared timbered lands are well adapted to the growth of tobacco, but it may be seriously questioned whether the best interests of the human race are promoted by its cultivation. On the river bluffs, and the region immediately adjacent thereto, where the Loess is the prevailing formation, the soil is more sandy and drains freely, and is well adapted to the cultivation of grapes, and all other fruits adapted to the climate. The rich alluvial bottom lands on the western borders of the county, have already been described on a preceding page.

In closing my report on this county, I desire to acknowledge my obligations to Dr. Benj. Norris, and Prof. Pike, of Pittsfield, for valuable information and voluntary assistance, while we were engaged in prosecuting the survey of the county. To Dr. Norris, the State Cabinet is also indebted for several valuable specimens of fossils, and Indian antiquities from this county.

CHAPTER III.

ADAMS COUNTY.

This county lies upon the western border of the State, and is bounded, on the north, by Hancock county; on the east, by Schuyler, Brown and Pike counties; on the south, by Pike county; and on the west, by the Mississippi river. It embraces an area of about twenty-three townships, or eight hundred and thirty square miles. It is well watered, having, in addition to the great river which forms its western boundary, several smaller streams, which afford a thorough surface drainage to all parts of the county. Bear creek drains the northern portion of the county; McGee's creek, the eastern and central; and McDonald's creek, Hadley's creek, and Mill creek, intersect the southern and southwestern portion. These streams furnish a small amount of water power for mills and machinery, as well as an abundant supply of water for the stock grower. Fine springs of fresh water are abundant in some portions of the county, and more especially, in the southern and western part, where the Burlington or Quincy limestone is the prevailing rock. This limestone is somewhat cavernous, and admits the free passage of subterranean streams through it, until they finally find an outlet at the surface, in limpid springs of cold limestone water.

The uplands in this county are nearly equally divided into timber and prairie, the timber portions being mainly restricted to the broken lands in the vicinity of the streams. The prairies are generally quite rolling, except in the northeastern portion of the county, where they are comparatively level. The general elevation of the prairie region, above the level of the Mississippi, at low water, is from two hundred to two hundred and eighty feet. Along the western border of the county there is a belt of alluvial bottom land, from one to five miles in width, extending the whole length of the county, from north to south, except for about two miles in the vicinity of the city of Quincy, where the bluffs approach near to the river bank. A portion of these alluvial lands are quite dry, being only overflowed by the highest floods in the river, and possess a very rich and productive soil, and are partly prairie, especially the higher portions adjacent to the river bluffs. The low bottoms are in part covered with a heavy growth of timber, embracing many varieties not found on the uplands. The bottom lands north of Quincy, towards the Hancock county line, are intersected with numerous bayous, and in the northeast corner of the county, one of these widens into a lake four or five miles in length, by about two in width, known as Lima Lake. The bottom lands in this part of the county, are mostly too wet for cultivation, but below Quincy, they are rather higher, and afford some fine farming lands, especially along the foot of the bluffs, where a considerable area is above the high water level of the river.

The geological formations exposed in this county, comprise the Lower Carboniferous limestone series, about three hundred feet in thickness, about one hundred feet of the lower part of the Coal Measures, and the Quaternary and Post Tertiary deposits of more recent age, which unconformably overlie all the others. The following section will show the thickness and relative position of the formations exposed in this county:

		FEET.
Quaternary	Alluvium and Loess	30 to 40
	Drift clay, with gravel and boulders	80 " 90
	Post Tertiary soil	2 " 6
	Brown clay	6
	Tough blue clay	20
Coal Measures	Beds of sandstone, sandy, and argillaceous shale, with bands of limestone, bituminous shale and fire clay, with two or three seams of coal	100
Lower Carboniferous Limestones.	St. Louis group	40 to 50
	Keokuk group	80 " 100
	Burlington Limestone	100
	Kinderhook group, partly exposed	50

The Quaternary system properly includes all the deposits, both stratified and unstratified, that are of more recent origin than the Pliocene Tertiary. In this county, we find a series of beds, comprising an aggregate thickness of about one hundred and sixty feet, which properly belong to this system. They include the surface soil and subsoil, on the uplands, and the alluvial deposits of the river valleys, the Loess, which is largely developed along the bluffs of the Mississippi, the Drift proper, including all the thick beds of unstratified clay and gravel, enclosing boulders of large size, and lastly, an ancient Post Tertiary soil and subordinate clays, usually distinctly stratified, and without boulders, which rest immediately upon the stratified rocks.

The soil at different localities, rests upon, and is, in part, derived from each of these subdivisions of the Quaternary system, and consequently varies considerably in its general appearance and productive qualities, in accordance with the character of the beds on which it rests, and from which it has been mainly formed.

The Alluvial deposits of the Mississippi valley, consist of partially stratified sands, alternating with dark bluish gray, or chocolate brown clays, deposited by the annual floods of the river. In the vicinity of the bluffs, these deposits are annually increased by the wash from the adjacent hills, and the sediments that are carried down by the small streams during their frequent overflows.

The valley of the Mississippi has been excavated in solid limestone strata, to the depth of from one hundred and fifty to three hundred feet or more, and from five to ten miles in width, and as we frequently find some portions of this valley still occupied by beds of unaltered drift material, exactly like that which covers the adjacent highlands, we have undoubted evidence that it was not formed by the river which now, in part, occupies it, but is due to some other and more potent agency, dating back to a period long anterior to the formation of the existing water courses. It is very evident, that the surface of the stratified rocks in this portion of the State, have been subjected to the action of powerful denuding forces, anterior to the accumulation of the superficial materials which now occupies the surface, by which these rocks were greatly eroded, and in many places cut into deep valleys, some of which now form our river courses, while others are wholly or partially filled with Drift and Post Tertiary beds, and it is highly probable that, if we could see a complete section of the beds which now occupy these ancient valleys, we should find beneath the alluvial beds already described, deposits even older than any which now cover the adjacent highlands. Along the banks of the water courses, we find only from ten to twenty feet of the alluvial beds exposed by natural causes, and the character of the underlying strata can only be determined by artificial excavations.

The next older division of this system, is the Loess, a deposit of marly sand and clay, which ranges in thickness from ten to forty feet, and attains its greatest development where it caps the river bluffs, thinning out rapidly towards the adjacent highlands, which form the summit level of the interior portion of the county. It is usually of a light buff, brown, or ashen gray color, frequently showing distinct lines of stratification, and always overlies the drift clays, when both are present in the same section. It is usually quite sandy, where it caps the river bluffs, but becomes more argillaceous at other points where the beds are thinner, and, locally, it becomes quite calcareous. The Loess is well exposed in the bluffs at Quincy, where it is about forty feet in thickness, and overlies some beds of plastic clay and sand, which are probably of Post Tertiary age, and older than the true drift. Immediately above the limestone here, we find a few feet in thickness of what might be called "local drift," consisting of angular fragments of chert, embedded in a brown clay, which have probably been derived from the subordinate limestones. This is overlaid by a few feet of blue plastic clay and stratified sands, on which the Loess is deposited. At one point, near the base of the bluffs, in the northern part of the city, we observed underlying the Loess, what seemed to be a chocolate colored soil, about a foot in thickness, which may represent the Post Tertiary soil, penetrated in the shaft, at Coatsburg, underlying the Drift deposits. Here the true Drift is wanting, and the Loess directly overlies these older Post Tertiary beds. Notwithstanding the unsolidified character of this deposit, it is sufficiently coherent to present a vertical cliff where it is intersected by artificial cuts, and often remains for years in nearly perpendicular walls, where it has been cut through by running streams, or in grading the streets of the cities that have been built upon it. It is, everywhere, a fine sedimentary accumulation, and usually contains numerous terrestrial and fresh water shells, which, notwithstanding their fragile structure, are found entirely perfect, showing that they have not been subjected to any violent movements before they were buried in the marly sands of this formation. The remains of the Mammoth, Mastodon, Megalonyx, Casteroides, and other extinct animals, occur in the Loess, indicating that it is a deposit formed in a fresh water lake, into which the bones of land animals, and the shells of terrestrial molluscs, were swept by the streams running into it from the adjacent land. The term "Loess," was originally applied to a similar formation, which caps the bluffs of the river Rhine, in Germany, and has been generally adopted by American geologists to designate beds that are similar in their character and origin, to those on the Rhine, and that appear to have been formed at about the same time.

Drift.—This formation is composed of yellowish, brown or blue clays, with sand, gravel, and large boulders of water-worn rock, the whole mass usually showing little or no trace of stratification, and ranging in thickness from thirty to eighty feet or more. It is a heterogenous mass of the water-worn fragments of all the stratified rocks that are known to occur for several hundred miles to the northward, embedded in brown or blue clays, and most of the large boulders which it contains, are derived from the metamorphic sandstones, granites, sienites, porphyries, and other metamorphic and igneous strata that occur on the borders of the great lakes. Associated with these, there are also rounded boulders, usually of smaller size, derived from the stratified rocks of this and the adjacent States. Fragments of native copper, galena, coal and iron ore, are often intermingled with the general mass, but are not indicative of mines of those minerals in the immediate vicinity where such fragments are found, for they have been transported from other localities by the same powerful agencies to which the Drift formation owes its origin. The coal shaft at Coatsburg penetrated the thickest bed of Drift that has, perhaps, been found in this county, and I am indebted to Mr. Joseph Edwards, for the following section of the beds passed through in sinking this shaft:

	FEET. IN.
Soil and yellowish clay	6 00
Bluish colored clay and gravel	45 00

Clay, with large boulders	40 00
Black soil	2 6
Clay, stratified	6 00
Very tough blue clay	20 00

We have in this section eighty-five feet of what may be considered true Drift, consisting of unstratified clays containing gravel and boulders. The upper six feet of the section probably represents the age of the Loess more properly than any other division of the Quaternary system, and its formation is explained by Prof. Lesquereux, in his chapter on the formation of the prairies, published in vol. I of this report, page 246 *et seq.*

The ancient Post Tertiary soil, which was reached at a depth of ninety-one feet from the surface, and the stratified clays which underlie it, are of an older date than the Drift proper, and were no doubt formed under very different conditions. So far as we are aware, this was the first point in the State where a bed resembling the surface soil was observed below the Drift, as this shaft was sunk in 1859, but no public notice was made of it at that time, as it was then supposed to be a merely local phenomenon that might not be verified elsewhere. Fragments of wood, and also of bones, were reported to have been found in it here, but we were not able to obtain specimens of them, and cannot vouch for the truth of the report. Susequent discoveries at other points, however, show that wood, in an excellent state of preservation, is often found in this ancient soil, as well as in the underlying stratified clays, and in the shaft at Bloomington, at the depth of one hundred and eighteen feet, a considerable quantity of wood, some of which was perfectly sound, was taken from a similar deposit These stratified clays, and the sands frequently associated with them, appear to have been entirely of fresh water origin, the fossil shells which they have afforded being all of lacustrine or fluviatile species.

At Camp Point, a few miles east of Coatsburg, the Quaternary beds were all penetrated in sinking a tank well at the railroad station. They were here only sixty feet in thickness, but no note was made of the character of the different beds passed through. Probably the lower beds of stratified clays, and the ancient soil above them, were not found here, and the beds passed through were only the surface soil and subsoil, and the true Drift deposits. From the soft and yielding character of the beds, a satisfactory natural section of them is rarely met with, and it is only where they have been penetrated in sinking coal shafts, wells, and other artificial excavations, that a correct section of the whole series can be seen. Along the breaks of the streams, the Drift clays and subordinate beds of superficial material are generally eroded into sloping hill sides, covered with soil and vegetation, down to the fundamental rock on which they rest, and only very meagre exposures of the beds are to be found on the water courses.

Fossils are but seldom found in the Drift accumulations, and they consist entirely of the remains of mammalia; no shells, either marine or fresh water, having yet been found in them in this State.

Carboniferous System.

All the paleozoic rocks that appear above the surface in this county, belong to this system, and comprise the lower portion of the Coal Measures, and the whole series of the Lower Carboniferous limestones, except the Chester series, and the lower part of the Kinderhook group.

Coal Measures.—This term is applied to that portion of the Carboniferous system that contains the workable seams of coal, and comprises shales, sandstones, bituminous slates, and thin bands of limestone, with seams of coal and the fire clays that underlie them. The whole thickness of these strata in this county, probably nowhere exceed about one hundred and twenty feet, and they include the three lower coal seams, and the strata associated with them. The greatest development of this formation is in the northeast part of the county, on Little Missouri creek, where there is an exposure of some fifty or sixty feet of shales with two thin beds of limestone, above No. 2 coal, which is worked at different points in the valley of the creek.

The following section will show the general arrangement and thickness of the coal strata, as they are developed in this county:

	FT.	IN.
Hard, gray, nodular limestone	3 to 6	
Sandy shale and sandstone	25 " 30	
Black shale	2 " 4	
Coal, No. 3, sometimes wanting	1	8
Fire clay	2 " 3	
Clay shale	25 " 30	
Coal, No. 2	2 " 3	
Fire clay and clay shale	4 " 10	
Gray nodular limestone	4 " 5	
Shale	10 " 15	
Bituminous slate	1 " 3	
Coal, No. 1	1½" 2	
Shale and sandstone	20 " 30	

The middle coal seam in the above section, (No. 2,) is the most regular in its development, and furnishes altogether the best coal in the county. It outcrops on the south fork of Bear creek, and is worked by Mr. Ferguson, on the northeast quarter of section 17, township 1 north, range 6 west. The coal at this point ranges from two to three feet in thickness, and is of good quality, being generally quite free from the bi-sulphuret of iron. The roof is a bluish clay shale, of which, about fifteen feet in thickness is exposed at the mine, above which there is a thin seam of bituminous shale and soft coal, indicating the horizon of another coal seam, which has been opened on another branch of the creek, about half a mile southeast of Ferguson's mine. The coal in this upper seam, which we refer to No. 3, is only from eighteen to twenty inches in thickness, and is full of iron pyrites, at the only point where it had been opened in this vicinity. It is overlaid by about two feet of black slate, and by eighteen to twenty feet of sandstone.

A mile and a half southwest of Ferguson's, on section 19, coal has been mined for several years, by stripping the seam along the valley of a small creek, a tributary of Bear creek, but the mines are now abandoned.

On Little Missouri creek, six miles northeast of Clayton, coal is dug in the same manner, by stripping the seam in the creek valley. The seam is here about twenty-eight inches thick, and the coal is of good quality. This is on section 12, township 1 north, range 5 west. On the southeast quarter of section 12, township 2 north, range 5 west, this seam has been worked on Cedar creek. The coal is here about thirty inches thick, and is underlaid by a white fire clay, and overlaid by fifteen or twenty feet of clay shale.

On the southwest quarter of section 34, township 1 north, range 5 west, about a mile southwest of Clayton, a thin seam of coal was opened in the early settlement of this part of the county, where the coal outcrops on a small branch of McGee's creek. The coal was found to be only from fourteen to sixteen inches thick, and was overlaid by four feet of black shale, which contained a few fossil shells, among which were, *Discina nitida*, and an *Aviculo-pecten*. This is, perhaps, coal No. 3, of the above section. On the northeast quarter of section 36, township 2 north, range 8 west, coal was dug at an early day on Mr. Higby's land. The coal was found here in the bed of a small creek, with no exposure of the beds associated with it, and was mined by stripping the seam of the overlying soil and clay. It was said to be from two to three feet in thickness, with six inches of blue shale, and about a foot of black shale above it. The coal was rather poor in quality, and is probably an outlier of the lower seam, No. 1. The coal was underlaid by sandstone, which was exposed near by, and a half mile southwest of this point, the concretionary limestone of the St. Louis group was found in *situ*.

South of Clayton, the country becomes quite rolling and hilly, but the ravines seldom expose the bed rock, and no coal is found outcropping, though it probably underlies most of the surface, north of McGee's creek. After crossing this creek at Hughes's ford, coal is found in the bluff on the south side, on section 28, township 2 south, range 5 west, while below it, are outcrops of the St. Louis and Keokuk limestones, the latter forming the bed rock in the creek valley. The coal seam has been opened here by Mr. Luke Snow, at two points; one in the face of the bluff, where a tunnel has been commenced, and the other, on a small ravine still further south, where the seam has been worked in an open trench on the outcrop. The coal is here from eighteen to twenty inches thick, and is overlaid by about two feet of bituminous shale, above which, about six feet of clay shale was seen. The beds immediately below the coal were not exposed, but we are inclined to regard this as an outcrop of the lower seam, No. 1. On the northeast quarter of section 31, township 2 south, range 5 west, there is an outcrop of coal that was known as Bassett's coal bank, and was worked at the time of our first visit to this part of the county, in 1853. The coal is here from sixteen to eighteen inches thick, and is overlaid by about two feet of black shale, containing numerous fossils, among which were a large *Discina*, perhaps only a variety of *Discina nitida*, *Aviculopecten Coxana*, *A. pellucidus*, *Productus muricatus*, *Orthisina crassa*, *Orthoceras Rushensis*, and *Pleurophorus soleniformis*. On the southwest quarter of section 7, township 3 south, range 6 west, there is a similar outcrop of coal and bituminous shale, the latter containing the same fossils as at Bassett's. South of Liberty, and west of Kingston, coal outcrops at various localities on the head-waters of McDonald's creek, and before the construction of the C. B. & Q. railroad, the beds were worked quite extensively, and the coal hauled on wagons to supply the Quincy market. Since the construction of the railroad, however, coal can be more cheaply obtained from the mines in McDonough county, and those formerly worked in this part of the county, have been generally abandoned. There is, however, a little coal still dug in this vicinity, to supply the demands of the immediate neighborhood. An analysis of Bassett's coal, reported in Dr. Norwood's "Analysis of Illinois Coals," made by Mr. Henry Pratten, gave the following results:

Specific gravity	1.2684		
Loss in coking		42.52	
Total weight of coke		57.48	
			100.00
Analysis: Moisture	9.20		
Volatile matters	33.32		
Carbon in coke	51.48		
Ashes, pale red	6.00		
			100.00
Carbon in coal	55.91		

The Coal Measures in the south part of this county, as in Pike, are quite irregular in their development, and seem to assume the character of outliers from the main coal field. North of Columbus, the three lower seams are found in their regular order, although not all equally constant in their development. Coal No. 2, or the Colchester seam, is by far the most constant, and will probably be found underlying nearly all of townships 1 and 2 north, in ranges 5 and 6 west, in this county, and may be reached by shafts, at a depth varying from seventy-five to one hundred and fifty feet, according to the thickness of the Quaternary beds at the different points. At Camp Point, No. 2 was found at the depth of ninety feet, and at Coatsburg, at 129 feet. Its general thickness is from two to two and a half feet, being about the same here as in McDonough county. The quality of the coal is good, but the seam seldom has a good roof, and, consequently, requires considerable expenditure for cribbing, where the mines are to be worked permanently. South of Columbus, there is no development of coal in this county, that would justify the expectation of its ever becoming a valuable mining region, though considerable coal may be found in the vicinity of Liberty and Kingston, extending south to the Pike county line, perhaps sufficient for the local supply of that part of the county for some years to come. Mill creek, on the western borders of this region, and McGee's creek, on the east, show continuous exposures throughout their whole course of the Lower Carboniferous limestones, that lie entirely below the Coal Measures, and clearly define a horizon, below which no workable coal seam has ever been found. These limestones may be reached any where over the coal field in this county, at a depth of from one to two hundred feet, and when reached, a further search for coal, by going deeper, will only result in failure. In the northern portion of the county, the Coal Measures rest upon the St. Louis limestone, and hence the outcrop of this rock is a valuable guide, in determining the boundary of the coal area; but in the southwestern part of the county, this limestone is not found, and the Coal Measures rest upon a lower division of the Lower Carboniferous series, as they also do in Pike county. This has resulted from the erosion of the limestone strata before the coal epoch, by which the upper beds have been wholly, or partially removed, allowing the Coal Measures to rest unconformably upon the lower divisions of the series. But whenever any division of this limestone series is reached in searching for coal, it is entirely useless to extend the search below that horizon.

St. Louis Limestone.—This division of the Lower Carboniferous series, as has already been remarked, usually forms the substratum on which the Coal Measures rest, and will be found outcropping immediately below the sandstone which forms the base of the Coal Measures, in the northwestern, as well as the southeastern portions of the county. The upper division of this formation is usually a light gray concretionary, or brecciated limestone, from five to twenty feet in thickness, below which, there is usually a regularly bedded brown, or brownish gray magnesian limestone, from ten to twenty feet thick, which locally becomes shaly, and passes into a calcareous or argillaceous shale. The concretionary limestone sometimes contains irregular seams of green shale, or marly clay, disseminated through it, and at some points, as at Butt's Mill, on McGee's creek, is entirely replaced by green shales. At this point, there is about thirty feet in thickness of this group exposed, consisting of regularly bedded limestones at the base, passing upward into green and bluish colored shales, which are overlaid by ferruginous sandstone, the latter representing the base of the Coal Measures. On Waters's Branch, a half mile south of this mill, there is a fine exposure of the regularly bedded limestone of this group, about ten feet thick, forming a perpendicular wall along the banks of the creek. There is a bed of earthy gray limestone about four feet thick, intercalated in it at this point, that appears like a hydraulic rock. The concretionary member of this group, outcrops on the upper course of McGee's creek, three miles southeast of Columbus, and with the regularly bedded limestones below, continues along the bluffs of this creek, through its whole course in this county. In the vicinity of Hughes's ford, on section 27, township 2 south, range 5 west, the brown magnesian limestone of this series is well exposed, the bed ranging from ten to fifteen feet in thickness. It is about thirty feet above the bed of the creek, and overlies the geodiferous shales of the Keokuk group, which extend below the creek level. In the Coatsburg coal shaft, this limestone was reached at a depth of about one hundred and forty-seven feet, and the shaft was carried on through it, and into the geodiferous shales of the Keokuk group, where it terminated at a depth of about two hundred feet. On the Walnut fork of Mill creek, about four miles a little south of west from Columbus, this limestone is exposed on the southeast quarter of section 21, township 1 south, range 7 west, and as it is only about seven miles to its outcrop on McGee's creek, east of that town, it is probable that it constitutes the bed rock entirely across the divide between these points, and separates the coal, south of Columbus, from that in the north part of the county. In the vicinity of Mendon, this limestone was met with at several points, and is overlaid by the coarse quartzose sandstone of the Coal Measures. Here the upper part of it is a light gray, more or less concretionary rock, from ten to twelve feet in thickness, below which, we find the brown magnesian limestone, and the shaly beds, which form the lower division of the group. This limestone is also found well exposed on the tributaries of Bear creek, in township 2 north, range 8 west, and on the main creek, on its upper course, for some distance further east, where it passes beneath the Coal Measures, and the latter becomes the bed rock over all the northeastern portion of the county.

This limestone may be readily distinguished from any of the lower divisions of the Lower Carboniferous series, either by its lithological characters or the fossils which it contains. The light grey concretionary limestone, is characterized by two species of fossil corals, one or both of which may be found at nearly every locality where the rock is exposed, and are often met with in fine specimens, weathered out of the limestone, and lying in detached masses in the debris along the streams. They are generally silicious, and where they have not been rolled and water-worn after being detached from the rock, they retain perfectly their original form and are frequently of a reddish pink color from the silicious matter, which has replaced the carbonate of lime in the original coral. These corals belong to the genus *Lithostrotion*, and are known as the *L. canadense* and *L. proliferum*, and the former species, which usually occurs in massive forms, is popularly known as "petrified honey comb," from the polygonal form of the numerous calyces of which it is composed.

In the magnesian and shaly beds of this group, fossils are usually quite abundant, and among the most striking forms we may mention the screw shaped fossil, known as the *Archimedes*, the axis of a peculiar form of *Bryozoa*. The largest form of this interesting genus, the *A. Wortheni*, of Hall, is found abundantly through the shaly beds of this group, and some of the largest specimens attain to a foot or more in length. Various other forms of *Bryozoa* also abound in this rock, and at some localities, the magnesian beds of this group appear to be in good part composed of the delicate, reticulated remains of this class of organic forms. Marine shells are also abundant in the same beds, among which are *Spirifer lateralis*, *S. sub-æqualis*, *Rhynchonella mutata*, *R. subcuneata*, *Retzia Verneuiliana*, *Orthis dubia*, *Terebratula hastata*, *Platyceras*, *acutirostris*, and *Productus Altonensis*. A knowledge of these species will enable the observer to identify this formation wherever it may appear, as some of them have a wide geographical range, especially the *Lithostrotion canadense*, which is known to range from Illinois to Alabama, and on a recent visit to Utah, we found it embedded in the highly metaphoric limestones of the Wahsatch mountains, within twenty miles of Salt Lake City. Hence we may understand the great value of fossils to the geological observer, as they enable him to establish the identity of strata at widely separated points, where the lithological characters of the beds are completely changed, and where it would be impossible to trace the continuity of the strata.

Keokuk Group.—This group immediately underlies the limestone just described, and usually appears in two well marked divisions. The upper one consists of bluish gray or grayish brown calcareo-argillaceous shales, and shaly limestones, enclosing silicious geodes of various sizes, some of them a foot or more in diameter, a part of which are solid spheres of crystalline quartz, covered externally with a thin coating of chalcedony, while others are hollow, and have their inner surfaces covered with beautiful crystals of quartz, calcite, or dolomite, or with the mammillary forms of chalcedony. Crystals of arragonite, iron pyrites and zinc blende are are also occasionally found in these silicious geodes, and the finest cabinet specimens of the crystallized minerals above mentioned to be found in this State, are obtained from this bed. The shales and shaly limestones in which the geodes were originally embedded, yields readily to the influence of frost and moisture, and the silicious geodes are readily weathered out and may be found in great numbers in the beds of the small streams by which this formation is intersected. The Coatsburg coal shaft terminated in this bed at a depth of about two hundred feet below the surface, and we obtained several finely crystallized geodes here in 1860, from the material that had been thrown out of this shaft. This division of the group is about forty feet in thickness, and is well exposed on McGee's creek, and some of its tributaries, and also on Bear creek, and some of the smaller streams in the western part of the county. Locally, this portion of the group becomes quite calcareous, and the beds are then filled with the same species of fossil shells and corals that characterize the lower division. Another species of *Archimedes* much smaller than that found in the St. Louis group, called the *A. Owenana*, occurs both in the upper and lower divisions of this group, and is the oldest known form of this interesting genus of fossil *Bryozoa.*

The lower division of the Keokuk group, consists mainly of bluish gray limestones in quite regular beds, varying from six inches to two feet in thickness, separated by intercalations of buff or blue shale, or marly clay. Towards the base it is very thin bedded and cherty, the flinty material predominating greatly over the calcareous. These beds are well exposed in the upper part of the quarries at Quincy, especially in the northern part of the city, where extensive quarries have been opened in these cherty beds, and also on the small creek at Whipple's mill, where they gradually pass upward into the more regularly bedded limestones above. At Col. Jamieson's place, two miles northeast of Quincy, the regularly bedded limestones of this group, the equivalents of the beds quarried at Nauvoo and Keokuk are exposed, and higher up on the creek above mentioned, and a mile and a half further east, the quarries were opened in this limestone to furnish the foundation stone for Gov. Wood's mansion, in Quincy. These quarries afforded an evenly bedded, bluish gray, semi-crystalline limestone, in beds from six to twenty inches thick, and furnished large slabs of dimension stone, from the facility with which the rock could be split into the desired form The quarry rock at this point is directly overlaid by the brown shales of the geode bed.

From Quincy to the north line of the county, this limestone outcrops at various points along the river bluffs, and is well exposed on Bear creek, near the Lima and Quincy road, where it forms a mural cliff from forty to fifty feet in hight. It is also found on all the small streams in the west part of the county as far south as Mill creek, and on both forks of that stream, though not on the main creek. The regularly bedded limestones of this group, are mainly composed of organic matter, and are formed from the calcareous portions of the molluscs, crinoids and corals, which existed in such countless numbers in the carboniferous ocean during this period of the earth's history, as to furnish the greater part of the material required to form entire groups of limestone strata. All these animals secrete the carbonate of lime to form the habitations in which they live, and the solid integuments of their various parts, and these calcareous fragments, cemented together by the chemical precipitation of the mineral matters held in solution by the waters of the ocean, now constitute many of the limestones and marbles, out of which our cities are built, and which enter so largely, under various forms, into the economic uses of human life. The alternations of limestone with seams of clay or shale, indicate the changing conditions that prevailed in the ocean at this time, as these clay seams are formed by the muddy sediments that at various times were introduced by currents or other causes into the ocean, which, settling to the bottom, formed the shaly sedimentary strata by which the limestones are separated. The characteristic fossils of this group occur almost everywhere, that the rock is exposed. In the debris of the old quarries northeast of Quincy we found *Archimedes Owenana*, *Agaricocrinus Americanus*, *Actinocrinus pernodosus*, *A. biturbinatus*, *Spirifer Keokuk*, *Productus punctatus*, and *Zaphrentis dalii.* In the quarries at Quincy we obtained *Aviculopecten amplus*, *Spirifer striatus*, and *Productus semireticulatus*, from the cherty beds at the base of the group.

Burlington Limestone.—This formation differs but little in its lithological characters from the lower portion of the Keokuk limestone, but it is usually of a lighter gray color, and contains intercalated beds of buff or brown limestone, while the bands of argillaceous shale, which separate the beds in the Keokuk group, are not seen in this. There is, however, one band of green clay, or clay shale, from one to six inches in thickness, intercalated in the beds at Quincy about midway from the bottom to the top of the exposure at the lower end of the city, where the beds are well exposed. At the quarries in the upper layers of the limestone, opposite the steamboat landing, the cherty beds belonging to the Keokuk group are quarried, but in the lower part of the city, the underlying limestones are well exposed, and are extensively quarried to supply the demand for building stone, and for burning into lime. The rock is tolerably even bedded, and affords some layers two feet or more in thickness, which, when free from chert, may be cut with facility, and forms an excellent building stone.

The following is a section of the rocks exposed in the bluffs in the lower part of the City of Quincy:

	FEET.
Loess capping the bluff	62
Thin bedded, cherty limestone, (Keokuk.)	13
Light gray limestone, (Burlington.)	12
Band of green shaly clay, (Burlington.)	0 4 in.
Buff and light gray limestones, (Burlington.)	36

The lower forty-eight feet of this section belongs to the Burlington limestone, and furnishes most of the building stone, and limestone for the manufacture of quick lime, to supply the city and adjacent country. The light gray limestones are a nearly pure carbonate of lime in their composition, and often contain pockets, lined with beautiful crystals of calcite. The buff and brown layers contain carbonate of magnesia and iron in small quantities, and some of the lower beds of this formation are highly magnesian, and approach a true dolomite in their composition. On Mill creek, at the old mill, six miles southeast of Quincy, there is about forty feet of this limestone exposed, the lower part of which consists of alternating beds of light gray and brown limestone, all of which are probably more or less magnesian in their composition, and afford an excellent building stone, comparatively free from chert, and sufficiently massive to furnish dimension stone of any desired size. From this point, to the south line of the county, this limestone forms continuous outcrops along the river bluffs, the exposures ranging from twenty-five to fifty feet or more in thickness. This limestone outcrops only over a limited area in the southwest part of the county, and a line drawn from the city of Quincy to the southeast corner of township 3 south, range 7 west, would represent very nearly its eastern boundary, while its western would be determined by the river bluffs. The quarries at Quincy have afforded a good many fine examples of the fossils peculiar to this group, among which the following are the most common species: *Spirifer plenus*, *S. Grimesi*, *Athyris lamellosa*. *A. incrassatus*, *Chonetes Illinoisensis*, *Productus semireticulatus*, *P. punctatus*, *Metoptoma umbella*, *Platyceras Quincyensis*, *P. biserialis*, *Actinocrinus Verneuilianus*, *A. oblatus*, *A. Hageri*, *A. Christyi*, *A. pyriformis*, *Granatocrinus Norwoodi*, and *G. melo*. From the lower beds of this limestone, exposed in the river bluffs, between Mill creek and the south line of the county, we obtained *Actinocrinus carica*, a very rare species, not yet found at any other locality in the State, *A. unicornis*, *A. clarus*, *A. discoideus*, *A. verrucosus*, *Strotocrinus umbrosus*, *Codonaster stelliformis*, and *Pentremites elongatus*, with three species of *Platycrinus* not yet determined. At Quincy, we obtained a number of specimens of the remains of cartilaginous fishes, consisting of teeth and spines, and noticed one layer of limestone, in the upper part of the quarries, that was well filled with these fragmentary remains. The large spine, *Physonemus gigas*, figured on Pl. II, was obtained from the quarries at Thayer's mill, about a mile below the city. The "fish bed" of this division of the Lower Carboniferous series was first noticed at Quincy, and a fine series of teeth and spines were obtained from it as early as 1854.

The fossil shells and crinoids above named, are nearly all of them peculiar to this rock, and an acquaintance with them will enable the observer to distinguish this limestone from the Keokuk group, to which it is closely allied in its lithological characters, being largely composed, like that, of the calcareous portions of the marine animals that swarmed, in countless numbers, in the old Carboniferous ocean in which these limestones were formed. Nearly all of the purely calcareous strata of this formation, are made up of the remains of marine animals, in which the *Crinoidea*, or *Encrinites*, largely predominate, and hence it has been called the *Crinoidal*, or *Encrinital* limestone, by some of the early observers. It contains a good deal of chert or flint, disseminated through it in seams and nodules, sometimes forming irregular layers between the limestone strata, but more frequently in detached nodular or ovoid masses, in the limestones. These chert bands and nodules furnished the flints, so much used by the Indians in the manufacture of spears, arrow-heads, and other rude implements, and it was probably the most useful and valuable mineral known to them, anterior to their acquaintance with the white man.

This limestone will be found at the base of the bluffs, for a few miles north of Quincy, but at so low a level as to be seldom exposed by the natural outcrop of the strata. On Mill creek, it may be found for several miles up the creek, and on all the smaller streams, to the south line of the county, it forms the principal rock exposed.

Kinderhook Group.—Immediately beneath the Burlington limestone, we find a series of sedimentary strata, consisting of sandy and argillaceous shales, and thin beds of impure limestone, only a portion of which appear above the surface in this county, to which the name Kinderhook group has been applied, from their fine exposure near the village of Kinderhook, in Pike county. The first considerable exposure met with in this county, was at Fall creek, twelve miles below Quincy, where there is about thirty feet of this group to be seen in the creek bluffs beneath the Burlington limestone. The section here is as follows:

	FEET.
Burlington limestone	20
Sandy shale and sandstone	20
Thin bedded, silicious limestone	10
Shale to the creek level	6

This formation is altogether about a hundred feet in thickness, and frequently has a bed of black, or chocolate colored shale intercalated in the lower portion, which has led many to the belief that coal might be found in it. This black shale was reached, in the boring made just below the city of Quincy, in search of coal, at a depth of about one hundred and fifty feet, but does not come to the surface anywhere in this county. As it lies nearly four hundred feet below any coal seam known in this country, all the time and money spent in the search for coal in this formation, can only result in pecuniary loss and disappointment. This group is exceedingly variable in its lithological characters, and at some localities, it becomes quite calcareous, and consists mainly of calcareous shales and magnesian limestones. The bed of silicious limestone near the base of the above section, may represent the light blue, or dove colored limestone, called in the Missouri Report, "Lithographic Limestone," but at this locality, it appears more like a stratified flint than anything else. Fossils are quite abundant in the silicious gritstones at Kinderhook, and several points in Pike county, but none were found at the exposures on Fall creek. The outcrop of this formation in Adams county, is restricted to the vicinity of the river bluffs, from this creek to the south line of the county.

Economical Geology.

Bituminous Coal.—About one-half of the entire area of Adams county is underlaid by the Coal Measures, embracing the central and eastern portions of the county, and the strata developed here, include the three lower coal seams, and the beds usually associated with them, but the coal seams, except the middle one, are very irregular in their development, and therefore become of little value for the production of coal. The middle seam, or No. 2, the equivalent of the Colchester coal in McDonough county, is generally quite regular in its development, and will be found underlying most of the region north and east of Columbus. Its average thickness is a little over two feet, though it frequently attains to thirty inches, and sometimes to three feet. The coal it affords is of a fair quality, and in some respects, above the average of our western coals. The analysis of Bassett's coal, given on a preceding page, will serve to indicate the quality of the coal obtained from the southern part of the county, and may be compared with the following analysis of Higby's coal, two miles north of Mendon, which I believe to be an outlier of coal No. 1. This analysis was made by the late Mr. Henry Pratten, and is given in Norwood's "Analysis of Illinois Coals":

Specific gravity	1.3354	
Loss in coking	48.4	
Total weight of coke	51.6	
		100.00
Analysis: Moisture	10.0	
Volatile matters	38.4	
Carbon in coke	41.2	
Ashes (yellow)	10.4	
		100.00
Carbon in coal	48.0	

This is a heavier coal than that from No. 2, and contains about seven per cent. less of fixed carbon, according to the analysis here given. The coals from Nos. 1 and 3, are usually inferior in quality to that obtained from No. 2, and the two former are not likely to be found sufficiently persistent in their development in this county, to be of any great economical value for the production of fossil fuel. Over all the northeastern portion of the county, No. 2 has been found wherever the Measures have been penetrated to the proper depth, or where the right horizon has been exposed by natural causes. The principal drawback to the successful mining of this seam, is the shaly character of the roof, which is usually a blue clay shale, though it has been seen at a few localities where it was overlaid by a bituminous shale, which forms a good roof. This coal seam will afford, according to the usual mining estimates, about two million tons of coal to each square mile of surface which it underlies, and although at the present time, there is but little demand for coal except along the railroad lines, yet the time is not very remote, when a good coal, two feet or more in thickness, will be considered of sufficient value and importance to be opened, wherever it can be reached at a depth not exceeding one hundred to one hundred and fifty feet below the surface.

Building Stone.—All the principal limestone groups of this county, furnish more or less building stone of good quality, and there are but few points in the western part of the county, where some of them are not easily accessible in the bluffs or valleys of the streams. The Burlington limestone, which is extensively quarried at Quincy, is one of the most important and valuable deposits of building stone in the county, and as its aggregate thickness is about one hundred feet, nearly all of which may be used as a building stone, the supply from this formation alone might be fairly considered as inexhaustible. It is for the most part, a light gray, or nearly white semi-crystalline limestone, which cuts easily when free from chert, and is an excellent stone for dry walls, as well as for caps and sills, and all the ordinary purposes for which cut stone are required. The buff and brown layers contain a small per cent. of iron and magnesia, and the surface becomes more or less stained by long exposure, but the light gray beds are a nearly pure carbonate of lime in their composition, and generally retain their original color. The lower portion of the Keokuk limestone is similar to the Burlington in its composition, but is usually of a little darker bluish gray color. The brown magnesian limestone of the St. Louis group, is an evenly stratified rock, admirably adapted for common use in foundation walls, and especially for bridge abutments and culverts, where a rock is required to withstand the combined action of frost and moisture. This rock may be found in the bluffs of McGee's creek, through nearly its whole course in this county, and also on Bear creek and its tributaries, in the northwest part of the county. The bed is variable in thickness, ranging from five to twenty feet, and it often affords massive strata from two to three feet thick. In the vicinity of Ferguson's coal bank, four miles northwest of Camp Point, there is an outcrop of brown sandstone overlying coal No. 3, which seems to stand exposure well, as it forms a mural cliff, nearly twenty feet high, along the creek for some distance, and would probably make a durable building stone. There are but few counties in this State where good building stone is so abundant, and easily accessible to all parts of the county, as here.

Limestone for Lime.—Most of the limestone used in the manufacture of quick lime, is obtained from the Burlington limestone, in the vicinity of Quincy, and a large amount of this article is produced annually for the supply of the city and the adjacent country. The light gray beds of the Burlington, and the bluish gray strata of the Keokuk group, are either of them sufficiently free from silicious, or other foreign material, when carefully selected, to produce a quick lime of excellent quality. The upper or concretionary bed of the St. Louis group is also, at many localities, a very pure carbonate of lime, and may be found useful for this purpose in the eastern portion of the county, where the underlying formations are not accessible. Its outcrop is mainly around the borders of the coal formation, immediately below the sandstone conglomerate which usually forms the base of the coal series.

Fire and Potter's Clays.—The under clays of coal seams No. 1 and 2, are usually of good quality, and where the strata are of sufficient thickness, they become valuable deposits of fire clay, and may be successfully worked in connection with the coal seams. At some points, there is a bed of fine, light blue clay shale, intervening between these two coal seams, which, on exposure, weathers to a fine plastic clay, and forms an excellent potter's clay. This is the bed from which the clays used in the potteries at Ripley, in Brown county, have been obtained. This bed of clay shale is exposed at various points in this county, and will furnish an abundant supply of potter's clay, while the under clay of No. 2 may be used for the manufacture of fire brick.

Clay and Sand for Brick.—The sub-soil clays of this county, intermingled with the fine sand of the Loess, forms an excellent material for the manufacture of common brick, and may be obtained almost anywhere in the western part of the county, and there are but few points in the State that have produced as good an article of common brick, as has been manufactured for many years in the vicinity of Quincy. In the eastern part of the county, where the Loess is wanting, the sand for this purpose may be readily obtained in the alluvial valleys of the small streams These materials are so universally abundant, that almost every farmer in the county may find them at hand upon his own premises, for the manufacture of all the brick required for building purposes.

Soil and Timber.—As an agricultural region, this county is not surpassed by any other portion of the State of the same geographical area. The western portion of the county, including a belt of country from five to ten miles in width, adjacent to the river bluffs, and extending through its entire length, from north to south, is underlaid by the marly sands and clays of the Loess, and possesses a soil of remarkable fertility, with an undulating surface, which furnishes a free drainage, so that, with a rather porus sub-soil, it is less subject to the deleterious influences of remarkably dry or wet seasons, than the other upland soils of the county. The growth of timber on this variety of soil consists principally of red, white and black oak, pig-nut and shell-bark hickory, elm, black and white walnut, sugar maple, linden, wild cherry and honey locust. These lands are admirably adapted to the growth of fruit, and this portion of Adams county has been long and favorably known, as one of the finest fruit regions in this portion of the State.

On the breaks of McGee's creek, and its tributaries, the surface is considerably broken, and the soil, which is mainly derived from the Drift clays, is a stiff clay loam, better adapted to the growth of wheat and grass, than almost any other crop usually grown in this latitude. The growth of timber on this kind of soil consists mainly of two or three varieties of oak and hickory, which is the characteristic growth of the "oak ridges," that are so frequently met with on the small streams, in this and other portions of the State. In the northeastern portion of the county, there is a considerable area of comparatively level prairie, covered with a deep, black soil, highly charged with vegetable matter, derived from the annual growth and decay of the shrubs and grasses which clothe its surface. This black prairie soil is predicated upon a fine silicious brown clay sub-soil, which does not permit the surface water to pass freely through it, and hence these lands suffer greatly from a surplus of water during a wet season. They are very productive, however, when the season is favorable, and produce abundant crops of all the cereals usually grown in this latitude. A judicious system of drainage would add greatly to the productive capacities of this soil. The alluvial bottom lands bordering the Mississippi, are generally similar in their character to those in Pike county, and are heavily timbered with the same varieties mentioned in describing the bottom lands of that county, in the preceding chapter. Where these bottom lands are elevated above the annual overflow of the river, they are exceedingly productive, and rank among the most valuable farming lands in the county.

CHAPTER IV.

BROWN COUNTY.

This county embraces a superficial area of only about eight and a half townships, or three hundred and six square miles, and is bounded, on the north, by Schuyler county; on the east, by Crooked creek and the Illinois river; on the south, by Pike; and on the west, by Adams county. The county is well watered by the two streams already mentioned as forming its eastern boundary, and by McGee's creek, which traverses the southern part of the county, giving a complete surface drainage to its entire area. The general surface level of the uplands, ranges from one hundred to two hundred and fifty feet above the level of the principal streams, and a large portion of it was originally covered with a heavy growth of timber. The upland prairies are small, and mostly confined to the middle and western portions of the county. The bottom lands on the eastern border of the county, are mostly prairie, with belts of timber immediately adjacent to the water courses.

The uplands are generally rolling, and in the vicinity of the streams, the surface is cut into sharp ridges, separated by narrow valleys. The best soils upon the uplands, are those underlaid by the Loess, and are characterized by a heavy growth of the common varieties of oak and hickory, elm, sugar maple, black walnut, linden, wild cherry, honey locust, etc., and are restricted to the vicinity of the Illinois river bluffs. In their productive qualities, these lands are fully equal to the best prairie soils. Further west, on the tributaries of Crooked creek and McGee's creek, the timber is mainly oak and hickory, including two or three varieties of each, and the soil is generally a heavy clay loam, derived mainly from the brown clays of the Drift formation. The prairie soil is usually a dark chocolate clay loam, highly charged with humus, especially on the level portions, where the annual accumulations of animal and vegetable matters have been retained, and in its productive qualities, it ranks next to the timbered soils of the Loess. It rests upon a subsoil of argillaceous loam, which is also rich in the phosphates and carbonates essential to the growth of vegetation, and will furnish the essential elements to replenish the surface soil, when it becomes exhausted by a long continued and injudicious system of cultivation.

The bottom lands adjacent to the Illinois river, possess a light sandy soil, and when sufficiently elevated to be susceptible of drainage, and are protected from the annual overflow of the river floods, they are very productive. The timber of the bottom lands consists of cottonwood, soft maple, linden, ash, elm, black and white walnut, pecan, hackberry, sycamore, swamp white oak, bur oak, Spanish oak, coffee-nut, shell-bark hickory, honey locust, wild plum, crab apple, dogwood, etc. Although much of this land is now too wet for cultivation, being subjected to overflow from the periodical floods in the river, yet its surface is constantly rising, from the accumulations of sediment left by the river floods, and by the material constantly being deposited upon it by the wash from the neighboring highlands. Thus, the hills are being leveled, and the valleys filled up, a process constantly carried on now, as in all past time, by which, in the coming ages, every portion of the earth's surface will become fitted for man's use, and be made subservient to his interests. Every year adds to the area of tillable land on our river bottoms, and the time is not very distant, when their entire surface will be susceptible of cultivation.

Geology.

The geological formationt of Brown county, comprise the Quaternary, the lower portion of the Coal Measures, including the three lower coal seams, and the two upper divisions of the Lower Carboniferous limestones, as they are developed in this portion of the State. The following section will show the relative position and thickness of the formations above named, as they appear in this county:

	FEET.
Quaternary System, including Alluvium, Loess and Drift	80 to 110
Coal Measures	130 " 140
St. Louis Limestone	30 " 40
Keokuk group	40 " 60

The Quaternary System includes all the superficial beds of soil, sand, clay, gravel, etc., which cover up all the older formations, except along the streams where the Lower Carboniferous limestone has been laid bare by the action of running water. It is the newest, or last formed of all the geological systems, and includes among its fossils, only the living species of animals, and those closely allied to them. The term Alluvium, includes the surface soil and subsoil of the prairies, and the bottom lands along the borders of our rivers and smaller streams. Possibly, the former may correspond nearer, in the time of its formation, with the Loess, than with the deposits of the river valleys, but it has generally been considered as coincident with the latter, in its formation, and hence of Alluvial age. The Alluvium of the Illinois river valley, like that of the Mississippi, consists, so far as we may judge from the exposures in the banks of the river and the small streams by which it is intersected, of sands, clays, and vegetable mould, more or less perfectly stratified, and frequently replacing each other at short intervals. It has been formed, in part, from the transported material brought down by the river current, together with the vegetable and animal substances that decay upon the surface, to which is added, the sands, clays, and organic matter, that is washed down upon it from the neighboring hills.

The Loess is restricted to the region adjacent to the Illinois river bluffs, and attains a maximum thickness of nearly a hundred feet, but thins out gradually from the bluffs towards the central portions of the county. It consists of brown, and drab colored sandy, and marly clays, sometimes partially stratified, and varying in color, with the variable quantities of the oxyd of iron it contains. It is well exposed in the vicinity of Versailles, and forms the main portion of the hills adjacent to that town, and is exposed in the cuts along the Quincy and Toledo railroad, westward, nearly to Harshman Station. At Lagrange, the Loess and Drift formations overlie the Coal Measures, and are, by measurement, one hundred and ten feet in thickness, the greater portion of which may be included in the Loess. It contains here a few of the land and fresh water shells, which are the most characteristic fossils of this group at other points, but they are less abundant here than at Quincy, and many other localities in the State.

The Drift formation in this county presents the same general characters as in the adjacent counties, and consists of unstratified clay and gravel, usually of a brown or ashen gray color, containing boulders of igneous and metamorphic rocks disseminated through it; but most abundant in the lower portion of the deposit. As no rocks similar to these boulders are to be found within the limits of this State, it is evident that a large portion of the material composing this formation, has been transported from abroad, and by comparing specimens of these boulders with the nearest known outcrops of similar rocks in *situ*, it has been demonstrated that much of this material has been derived from the region lying to the north of Lake Superior.

The transportation of this Drift material has been brought about by the combined agencies of ice and water, during a period of submergence, while the entire area of this and several of the adjoining States was beneath the water level. Icebergs, impelled by winds, or currents of water, and loaded with the detritus of distant shores, were, no doubt, one of the most potent agencies in the accumulation of the Drift, and we find, as we trace this deposit southward from the Lake Superior region, that the boulders diminish in size and number, in that direction, until they entirely disappear.

When we consider the conditions under which the Drift formation has been accumulated, it seems hardly possible that valuable mineral deposits could be found in it, and, although we occasionally do find specimens of native copper, gold, and the ores of lead, iron, etc., in it, it is quite impossible, from the conditions under which the Drift has been accumulated, that it should contain any valuable deposits of these or any other metals or metallic ores. Small quantities of native gold are reported to have been found in the gravel and drifted clays of this and the adjoining counties, and possibly this may be true, but it is far more probable, that the substance mistaken for gold, was yellow mica or iron pyrites, derived from the Coal Measures which form the bed rock over a large portion of the county. These substances are often mistaken for gold by those who have no acquaintance with mineralogy, and most of the announcements made through the public press in regard to gold discoveries, have no other basis than the chance discovery, by some ignorant person, of one of the substances above named, coupled with their firmly expressed opinion that it is *pure gold.*

Although gold is frequently found in the gravel beds of the streams in the auriferous regions, it is always in close proximity to the gold-bearing rocks, from which the precious metal has been derived, for the specific gravity of gold is so great, that it is rarely transported for any considerable distance from the outcrop of the metamorphic rocks in which it occurs. The search for gold in the Drift deposits of this State could scarcely result otherwise than in disappointment and pecuniary loss to those who may engage in it, and the geologist, who, for a temporary notoriety, should encourage such an enterprise, would sooner or later receive his just reward in the contempt of all honest men.

Carboniferous System.

Coal Measures.—This term is usually applied to a group of strata, consisting of sandstones, shales, slates and thin beds of limestone, with the coal seams and fire clays, with which they are associated. Only the lower portion of this group is found in this county, including the three lower coal seams, and the strata associated with them. The highest beds of this group are found in the vicinity of Mount Sterling, where a hundred feet or more of strata may be found outcropping on the small creeks which run northward into Crooked creek. A section of these beds, down to the horizon of No. 2 coal, shows the following order:

	FT.	IN.
Nodular gray limestone, partially exposed	5 to 10	
Shale	20 " 30	
Black shale	4	
Purple shale	0	6
Coal, No. 3 ?	1	3
Shale and fire clay	15 " 20	
Rough gray limestone, passing into a ferruginous conglomerate	4 " 6	

	FEET.
Sandstone and sandy shale	15 to 20
Blue argillaceous shales	30 " 40
Shaly calcareous sandstone, with fossils	3 " 4
Argillaceous, or bituminous shale	8 " 10
Coal No. 2	1½" 2½
Fire clay	2 " 3

This lower coal seam is worked at several points northeast of Mount Sterling, in open trenches, along its outcrop, in the valleys of the small streams. Four miles northeast of that point, it is worked in this way by Mr. Miller, on a branch of Curry creek. The coal is about two feet in thickness, and of good quality, with about five feet of clay shale in the roof, above which there is a bed of black shale, that, at some other localities in this vicinity, rests directly upon the coal. Two miles north of Mount Sterling, a shaft was sunk by Mr. Graves to the depth of about ninety feet, when he struck the coal worked in this vicinity at that depth. The seam was found to be from 28 to 30 inches thick, which was not deemed sufficient to assure a paying investment in coal mining at this point, and the shaft was subsequently abandoned. Another shaft was sunk near Mound Station, with a similar result.

On Little Missouri creek, in the northwest corner of the county, on section 7, township 1 north, range 4 west, coal is dug at many points in the ravines which intersect the bluffs of the main creek. The coal ranges in thickness here from 24 to 30 inches, and is overlaid by clay shale, containing plants, and otherwise presents the usual characteristics of No. 2 coal. A section of the strata exposed in this vicinity, shows the following order of succession:

	FEET.
Sandy shales	8 to 10
Evenly bedded sandstone	" 8
Black shale	" 3
Limestone	" 4
Clay shale	25 " 30
Coal	2 " 2½

The black shale in this section may represent the horizon of coal No. 3, and if so, then the thin seam near Mount Sterling, which we have marked No. 3, with a query, is probably a local development. This seems most probable, as it presents none of the usual features of either No. 3 or 4, and we have seen no other outcrop of coal, either in this or the adjoining counties, that we can identify with this. If it represents No. 3, there is a great thickening of the strata at this point, for this coal is not usually more than forty or fifty feet above No. 2, whereas, in the section near Mount Sterling, the thickness of the intervening strata is from seventy-five to one hundred feet.

At the La Grange bluff, on section 29, township 1 south, range 1 west, the lower part of the Coal Measures are well exposed, resting upon the St. Louis group, consisting of limestones and calcareous sandstones, which outcrop at the base of the bluff. The following beds of the lower Coal Measures outcrop at this locality:

	FEET.	IN.
Shale	10	
Band of iron ore, with fossils	0	4
Shaly clay	3	
Limestone	1	
Bituminous shale	2	
Coal	2	6
Shaly fire clay	4	
Compact nodular limestone	4 to 6	
Shaly clay	15	
Ferruginous sandstone	15	

The horizon of coal No. 1, in the foregoing section, is between the ferruginous sandstone, and the bed of clay shale which overlies it, but no trace of coal was to be seen where this section was made. A little further to the northward, coal is said to have been found near the base of the bluff, and if so, it must have come from seam No. 1. The upper shale in the foregoing section, contains a calcareous band in the lower part of the bed, which is filled with fossil shells, among which, we observed *Productus muricatus*, and *Chonetes mesoloba*, and these species were also found in the band of iron ore below. The compact and nodular limestone below the coal, contains several species of univalve shells, belonging to the genera *Naticopsis Pleurotomaria*, and *Murchisonia*.

The clay shale below this limestone, affords the potter's clays so extensively used in this county in the manufacture of pottery, and its average thickness is fifteen feet. At Ripley, the same beds are exposed as at LaGrange, and show but little variation in their lithological characters, as may be seen from the following section at that point:

	FEET.	IN.
Micaceous sandstone	4 to 6	
Argillaceous shale	4	
Bituminous shale	3	
Coal No. 2	2	
Fire clay and shale	6	
Nodular bluish gray limestone	5	
Light gray clay shale (Potter's clay)	15	
Bituminous shale (Coal No. 1)	3	
Ferruginous clay	0	6
Quartzose sandstone	20	

The bed of sandstone at the base of this section, represents the conglomerate which usually forms the base of the Coal Measures, and is quite variable in thickness, ranging, in this county, from five to twenty feet, though it is frequently wanting altogether. For three or four miles south of LaGrange, this sandstone outcrops in a continuous mural bluff, from fifteen to twenty feet in hight, and when the lower coal (No. 1,) is developed at all, it will be found immediately above this sandstone.

From the preceding sections, a general idea may be had of the thickness, and lithological character of the Coal Measures, as they are developed in this county, and it only remains now to speak of the extent of surface which they underlie. Originally, they covered the entire area of the county, but in the subsequent excavation of the valleys of the Illinois river, and its main tributaries, the whole thickness of Coal Measure strata have been cut away, down to the underlying Lower Carboniferous limestones, into which all the principal streams have cut their channels, along the lower portion of their courses. Hence, the Coal Measures are now found only beneath the surface of the highlands, and in the valleys of the smaller streams, but they underlie nearly all the uplands in the county, except a limited area in township 2 south, range 2 west, in the vicinity of Versailles, where the hills consist of Loess. In this vicinity the Coal Measure strata have been removed by the same agencies that scooped out the main river valley, and the bluffs here are formed by the Quaternary deposits, that were subsequently deposited in, and now partially fill this ancient valley.

The principal coal seam developed in this county, is No. 2, or the Colchester seam of McDonough county, and it outcrops on most of the small streams, and may be reached by shafts almost anywhere on the uplands, in the central, northern, or western portions of the county, at a depth varying from one hundred to one hundred and fifty feet.

St. Louis Group—This group forms the upper division of the Lower Carboniferous series in this portion of the State, and consists of a hard gray concretionary limestone, varying from five to ten feet or more in thickness, which constitutes its upper division, and a brown magnesian limestone, and calcareous sandstone, with some intercalations of blue clay shale, which form the lower division of the group. Its entire thickness in this county, may be estimated at about forty feet. We found the upper division well exposed on the Dry Fork of McGee's creek, six miles south of Mount Sterling, at Tucker's old mill. The rock is here an irregularly bedded gray limestone, a portion of which is stained a deep rusty brown color, by the decomposition, or oxydation of the crystals of iron pyrites which it contains, and it also contains irregular seams of green marly clay. We obtained a few fossils from the beds at this locality, among which were *Lithostrotion proliferum*, *Archæocidaris Wortheni*, and *Granatocrinus cornutus*. The last named species has not been found at any other locality in the State. In the bluffs of McGee's creek, about a mile and a half below Jaqueth's mill, there is an exposure of about thirty feet of buff and brown magnesian limestones and shales, which belong to this group, and at the mill we found the following beds overlying the blue geodiferous shales of the Keokuk group:

	FEET.
Fine grained greenish sandstone	6
Brown shale	12 to 15
Brown magnesian limestone	8 " 10

In the river bluffs, about two miles southeast of Versailles, the brown magnesian limestone, which forms the lower division of this group, is exposed in the face of the bluff, and a quarry has been opened in it, showing about fifteen feet in thickness of regularly bedded limestone, which forms an excellent building stone. This quarry is about fifty feet above the level of the Illinois bottoms.

At LaGrange, there is from twenty-five to thirty feet of this group exposed at the base of the bluff. The upper portion is a gray limestone, about six feet thick, below which, there is about twenty feet, consisting of alternations of brown magnesian limestone, with calcareous sandstones and shales. The magnesian limestone at this point, is not as evenly textured as this rock usually appears, and some of the layers crumble readily, on exposure to atmospheric influences. This group is also exposed on a small creek, five miles west of LaGrange, on the Mt. Sterling road, the upper bed consisting of gray concretionary limestone, while the lower part is a brown magnesian limestone, about fifteen feet in thickness. The general outcrop of the St. Louis group in this county, is along the valleys of Crooked creek, and McGee's creek, and on some of their principal tributaries, and also along the base of the Illinois river bluffs, wherever the stratified rocks are exposed. In the vicinity of Ripley, we find this group outcropping in the bluffs of Crooked creek, affording, with the underlying shales of the geode bed, the following section:

	FEET.
Concretionary limestone	10
Brown magnesian limestone	15
Blue argillaceous shales, partly exposed	25

The two upper beds in the above section, belong to this group, while the lower, which at this locality was only partly exposed, belongs, for the most part at least, to the underlying Keokuk group. The magnesian limestone, and the calcareous sandstone of the St. Louis group, furnish the most durable building stone to be found in the county.

Keokuk Group.—Only the upper part of this group appears above the surface in this county, including the geodiferous shales, and a few feet in thickness of thin bedded limestone. These beds are exposed on the lower course of McGee's creek, and also on Crooked creek, along its whole course in this county. At Chambersburg, the thin bedded limestone which underlies the geodiferous shales, may be seen in the bed of McGee's creek, and they have afforded a few of the characteristic fossils of this formation, among which, were *Agaricocrinus Americanus*, *Archimedes Owenana*, and *Spirifer Keokuk*. This limestone outcrops along the bed of the creek, at intervals, as far west as township 1 south, range 5 west, in Adams county, the easterly dip of the strata corresponding very nearly to the fall of the creek.

At Jaqueth's mill, about six miles a little south of west from Versailles, the geodiferous shales of this group are well exposed, forming the base of the bluff, as shown in the following measured section, made at this point:

	FEET.
Fine grained sandstone	6
Brown shales	10 to 15
Brown magnesian limestone	8 " 10
Blue shales, with geodes	35 " 40

The lower bed in the above section consists of blue argillaceous shales, traversed by perpendicular veins of satin spar, from a quarter of an inch to an inch in thickness. The geodes from this locality contain beautiful crystals of brown and colorless calcite, dog-tooth spar, zinc blende, dolomite, iron pyrites, and the more common forms of crystallized quartz and chalcedony. They are mostly of small size in the bluff at the mill, but at other points they are larger and are mostly lined with quartz crystals. The regularly bedded gray limestones, which form the lower portion of this group, do not appear above the surface in this county, but would be found a few feet below the level of the main water courses.

Economical Geology.

Coal.—As has already been stated, the Coal Measures underlie nearly all the uplands in this county, and attain a maximum thickness of nearly one hundred and fifty feet, including the horizon of the three lower coal seams. Only one of these, however, No. 2, or the Colchester coal, of McDonough county, appears to be generally developed in this county, and from this, nearly all the coal mined at the present time is obtained. We found this seam very uniform in its thickness, and apparently extending over nearly the whole area underlaid by the Coal Measures. It affords a coal of good quality, and the only drawback to the success of coal mining enterprises in this county, is the thickness of the strata, which varies from twenty-four to thirty inches. The roof is generally a clay shale, though, at some localities, the lower part of it becomes highly bituminous, passing into a black shale, which forms an excellent roof. This seam is only worked in a very primitive way, by the process called "stripping," which consists of throwing off the overlying material, where the coal outcrops in the valleys of the small streams, and then taking out the coal where the seam has thus been laid bare. This seam is as thick here as it is in the vicinity of Colchester, where it is successfully worked, both by tunneling into the hillsides along its outcrop, and by shafts sunk to the level of the coal on the highlands. It will furnish about two million tons of coal to the square mile, and probably underlies at least two-thirds of the area of the county.

Coal seam No. 1 is quite irregular in its development, and at most points where we found the horizon of this coal exposed, we found the coal replaced by a thin bed of bituminous shale. Just above LaGrange, we were told that a seam had been formerly opened at the foot of the bluff, where the coal was about two feet thick, and if so, it must have been the lower seam. We also found an outcrop, at about the same horizon, on Little Missouri creek, near the north line of the county, on section 5, township 3 south, range 4 west, where the coal was about two feet thick, which, probably, is an outcrop of No. 1. It generally affords an inferior coal to that produced from the seam above it, and for that reason it will not be as extensively worked as the other seam, even when found of the same thickness.

The thin seam which outcrops a little northeast of Mount Sterling, may be the representative of No. 3, and if not, is a local development of coal, coming in between No. 3 and 4. It is the only seam met with in the county above No. 2, and its distance above that may be due entirely to a local thickening of the intervening strata. But, in the absence of the characteristic fossils that are usually found in connection with No. 3 coal, it is difficult to decide positively whether this seam should be considered as the equivalent of that, or as holding a higher position. However, as it is probably nowhere developed of sufficient thickness to be successfully worked, the question has no important practical bearing in estimating the coal resources of the county. No. coal will be found here below the beds of the main water courses, as we have already stated that these have been cut down quite through the Coal Measures, and into the upper divisions of the Lower Carboniferous limestone series, which underlie all the coal strata at present known in this country.

Potter's Clay.—This county has long been noted for the amount of potter's ware, annually manufactured within its limits. The potteries are mostly located in the vicinity of Ripley, though the bed of clay shale, which furnishes the material from which the ware is manufactured, is found outcropping at several other localities. It is exposed at LaGrange, and attains about the same thickness there as at Ripley, and lies between the two lower coal seams. The bed is about fifteen feet in thickness, but only the upper portion of it is used for pottery. Where it was first opened, the overlying beds had been carried away by Drift agencies, and the surface of the clay shale had been long exposed to the action of atmospheric influences, which reduced it to the condition of a tough, plastic clay, well adapted to the potter's use. The same effect may be produced on the freshly dug shales, by throwing the material into heaps, and allowing it to remain fully exposed, for a year or two, to the action of the atmosphere. About a dozen potteries have been established in the vicinity of Ripley, and this number may be increased indefinitely as the wants of the community shall require, as the supply of the raw material is abundant.

Fire Clay.—The under-clay of coal No. 2 is often pure enough for the manufacture of fire brick, though no attempt has been made, so far as I could learn, to test its quality in this county.

Building Stone.—This county is not so well supplied with good building stone as the counties lying south and west of it, where the older rocks outcrop more extensively. The quartzose sandstone, which forms the base of the Coal Measures, may sometimes be safely used for this purpose, and the massive beds of this rock, which outcrop at the base of the bluff, for three or four miles below LaGrange, seem to be sufficiently coherent in their structure to make a durable building stone. The brown magnesian limestone, and the calcareous sandstone, of the St. Louis group, may usually be safely used for this purpose; and the former is especially adapted to the construction of culverts and bridge abutments, where a material is required that will withstand the combined influence of frost and moisture. The sandstone below the upper coal seam, near Mount Sterling, appears to be a very good freestone, and the jail at that place has been built of this rock.

Limestone for Lime.—The best material for the manufacture of common lime, is the concretionary limestone, which forms the upper division of the St. Louis group. It is usually a very pure carbonate of lime, and is more extensively used for this purpose, than any other limestone in this portion of the State. Along the river bluffs, below LaGrange, this rock has been used at several points for this purpose, though at some localities it contains too much silicious or argillaceous material to make a pure lime. In the vicinity of Mt. Sterling, lime has been made from the nodular gray limestone, which lies between the two upper coals, and it is said to make a strong lime, suitable for mortar and cement, but darker colored than that made from the concretionary limestone of the St. Louis group.

Sand and Clay for Brick.—These materials are so common and abundant in this portion of the State, that it seems scarcely necessary to mention their occurrence at any particular locality, but as it is a primary object in all reports of this kind, to make known abroad the natural resources of the State, it seems hardly proper to entirely omit the mention of materials so nearly universal as these in their distribution. There is, perhaps, no mineral product of the State, if we except coal, more important to our vast prairie region, than the materials for the manufacture of common bricks, and there are but few branches of manufactures perhaps none carried on in this State in which so great an amount of labor and capital is annually employed. The subsoil clays at almost any point on the uplands in this county, may be used for brick making, and where this rests upon the sandy beds of the Loess, the necessary proportion of sand may be obtained on the spot, and at other localities, it may be readily found in the bed of some neighboring stream. As the country increases in wealth and population, the desire for more artistic and substantial dwellings will also increase, and with that, we shall have a just appreciation of the natural resources so abundantly placed at our command, for this purpose.

Soil and Agriculture.—There is, probably, no portion of this county, where the soil is so poor that it will not produce annually fair crops of most of the cereals grown in this latitude, without the stimulant of any fertilizer, other than that it naturally contains; but there are some soils more productive than others, and therefore more desirable for the agriculturist. First in rank, we should place the timbered lands of the Loess, characterized by a growth of sugar maple, elm, wild cherry, linden, etc., with the common varieties of oak and hickory. Next, the prairie lands, and lastly, the white oak lands, which occupy mainly the ridges along the breaks of the smaller streams. These last, however, are very good fruit lands, and also produce fair crops of wheat, oats, clover, etc. The principal growth of timber on these lands, is black and white oak, and hickory. They have a thin soil, with a heavy clay subsoil, which will improve under a liberal application of stable manure, applied annually, or by fallowing, and the plowing under of green crops. The prairie region is quite limited in this county, and confined to the northern and western portions. The bottom lands on the Illinois river are very productive, and where they are elevated above the annual overflow of the river, they may be ranked among the most valuable farming lands in the county. The soil is generally a sandy loam, and better adapted to the cultivation of corn than the uplands. The subsoil is, for the most part, quite sandy, which gives a free surface drainage, where the land is sufficiently elevated above the river level.

Mineral Springs.—The *Versailles Mineral Springs*, three or four in number, are situated about a mile northeast of the village, in a little valley surrounded by hills, composed entirely of Loess and Drift. The valley in which these springs are situated, was originally a part of the ancient valley in which the Illinois river now runs, and was excavated for a hundred feet or more, into the carboniferous rocks that were once continuous across the area now occupied by this valley, and are now found underlying the Quaternary deposits in the adjacent region. The springs, probably, originate in the Loess, or some other Post Tertiary beds, which now form the surrounding hills, and derive the small per cent. of mineral ingredients which the water contains, from these recent formations.

The following analysis of the waters, from three of these springs, were made in Chicago, the two first, by Dr. J. V. Z. Blaney, and the last, by Mr. Geo. A. Mariner, and gave the following results, as the total number of grains of solid mineral matter in an imperial gallon of water:

NUMBER 1.

Sulphate of Lime	2.0852
Chloride of sodium, a trace.	
Alumina, and a trace of iron	.7268
Bi-carbonate of Lime	17.4315
" Magnesia	12.5750
" Soda	10.9895
" Potash, a trace.	
Organic matter, a trace.	
Silica	.8177
Total solid matter in imperial gallon	44.6257

NUMBER 2.

Bi-carbonate of Iron, and trace of Alumina	2.1352
" Lime	23.2238
" Magnesia	11.7799
" Soda	10.9895
" Potash, a trace.	
Silica	1.7036
Chloride of sodium, a trace.	
Organic matter, a trace.	
Total solid matter in one imperial gallon	49.8320

NUMBER 3.

Carbonate of Lime	14.600
" Magnesia	8.950
" Iron	.060
" Soda and potassa	1.320
Chloride of sodium	.003
Sulphate of lime, a trace.	
Silica	1.400
Free carbonic acid	11.683
Total grains in one gallon	38.016

CHAPTER V.

SCHUYLER COUNTY.

This county embraces a superficial area of a little over eleven townships, or about four hundred and fourteen square miles, and is bounded on the north by McDonough and Fulton counties, on the east by Fulton county and the Illinois river, on the south by Brown county, and on the west by the counties of Adams and Hancock. Its surface is considerably diversified with hills and valleys, prairies and heavily timbered woodlands, the proportion of prairie and timber lands being about one of the former to three of the latter. Along the bluffs of Crooked creek, and the Illinois river, the surface is quite broken and hilly, but even these broken lands possess a rich and productive soil, and are valuable for agricultural purposes, wherever they are sufficiently level for cultivation. The prairies are mostly small, and are restricted to the northern and western portions of the county. The county is well watered, mainly by Crooked creek, and its affluents, which traverse its southern and western portion, and by Sugar creek and the Illinois river, the former intersecting the eastern portion of the county, and the latter forming, in part, its eastern boundary. Crooked creek furnishes considerable water power, and, in the early settlement of the country, the inhabitants of this, and several of the adjoining counties, were dependent upon the water mills upon this stream for nearly all their milling facilities. More recently, however, steam power has, to a great extent, superseded the old water mill, and most of the mills on this stream now have a steam engine attached, to enable them to run throughout the year.

On the ridges adjacent to the small streams, the timber is mostly black oak and hickory, but on the more level portions of the timbered region, as well as on the bluffs of the Illinois river, we find, in addition to these, elm, linden, sugar-maple, wild-cherry, and honey-locust, an arboreal growth which indicates a soil of the best quality, fully equal to the best prairie soils. Much of the upland, where this growth of timber prevails, is underlaid by the marly sands and clays of the Loess, and rank among the very best lands in the State. Fine blue grass pastures are easily made upon these lands, and the soil is well adapted to the growth of fruit, especially the grape.

On the eastern border of the county, there is a belt of alluvial bottoms skirting the Illinois river, from a half mile to about four miles in width. Some portions of this bottom land is above the high-water level of the river, and these lands are very productive, while other portions are subject to annual overflow from the river floods, and are of little value at the present time for agricultural purposes. A considerable portion of this is bottom prairie, but there is usually a belt of heavy timber skirting the river, and also the small streams by which the bottoms are intersected. The timber on these low lands comprise cotton-wood, sycamore, soft-maple, ash, elm, hickory, pecan, Spanish oak, swamp white oak, pin oak, black walnut, hackberry, buckeye, honey-locust, paw-paw, horn-beam, willow, etc. There are also narrow belts of bottom land on some of the larger creeks in this county, as on Crooked creek and Sugar creek, but these seldom exceed a half mile in width, and are covered with a heavy growth of timber, embracing most of the varieties mentioned as occurring in the Illinois river bottoms, with the addition of white walnut, sugar-maple, linden, white oak, etc.

The general surface level of the uplands in this county, ranges from two to three hundred feet above the level of the Illinois river, and the river bluffs often rise abruptly to the height of two hundred feet or more above the bottoms, but exhibit none of the bold limestone escarpments, so conspicuous on the lower course of the river, where the Lower Carboniferous limestones are the prevailing formations.

Geology.

The geological structure of this county, like that of Brown, includes the Quaternary system, the lower portion of the Coal Measures, and the upper divisions of the Lower Carboniferous limestones, but differs from that in an additional thickness of the Coal Measures sufficient to bring in another coal seam, No. 4, which is not found in any county south of this, on the west side of the Illinois river. The following section exhibits the formations to be found in this county, in their relative order of superposition and thickness:

	FEET.
Quaternary, comprising Alluvium, Loess and Drift	100
Coal Measures	200 to 250
St. Louis group	30 " 40
Keokuk group	60 " 70

The three lower groups belong properly to what are called stratified rocks, that is, to those that have been formed in regular strata or layers, and also to that division of geological time termed *paleozoic*, because the embedded fossils represent only ancient forms of animal and vegetable life, while the upper division belongs to the most recent geological age, and the fossils which it contains are the remains of species of animals now living, or but recently become extinct. Hence this formation is unconformable with those below it, and may be found immediately overlying either of them, even the lowest, if the others are absent. If the geological series was complete, we should have above the Coal Measures, and intervening between that formation and the Quaternary, the whole of the Secondary and Tertiary series, embracing many thousand feet in thickness of strata, and representing, in their fossil contents, all the missing links in the great chain of organic life, which connect the paleozoic age with the present. But as the Quaternary is the most recent of all the geological systems, it may be found resting directly upon any of the above deposits, from the Tertiary to the most ancient stratified or igneous rocks that outcrop on the surface of the earth. This system includes the alluvial deposits of our river valleys, usually termed Alluvium; the Loess, a deposit of buff-colored marly sands and clays, most conspicuous in the vicinity of the river bluffs, and the Drift, which usually consists of brown or bluish gray, gravelly clays, with water-worn boulders of various sizes, from an inch to several feet in diameter. There is probably no locality in the county where these deposits exceed a hundred feet in thickness, and they attain their greatest development in the vicinity of the river bluffs, where the Loess attains its greatest thickness, and rests upon the Drift clays. In the interior of the county, the Loess is generally wanting, and the drift deposits generally range from thirty to fifty feet in thickness, and consist of unstratified clays, with sand and gravel, enclosing water-worn boulders of granite, sienite, gneiss, porphyry, horn-blende and quartzite, and also the rounded fragments of the limestones and sandstones of the adjacent region. Fragments of copper, lead ore, coal, iron and other minerals are often found in the Drift, or in the gravel beds in the valleys of the small streams, but their occurrence in this position is no indication of the proximity of any valuable deposit of these minerals, and the fragments which are found in this position are far removed from the beds from which they originally came Small quantities of gold are reported to have been found in the washed gravel of this formation, but nowhere yet in sufficient quantity to pay the ordinary price of the labor necessary to secure it, and it is quite certain that, in many cases, the material mistaken for gold, is either pyrites of iron or yellow mica; the former, derived from the Coal Measures or other stratified rocks of the adjacent region, and the latter from the decomposed boulders of sienite or gneiss, transported from the northern shores of the great lakes.

Carboniferous System.

Coal Measures.—This term is applied to the upper division of the Carboniferous System, and it embraces all the coal seams and the associated strata, and when fully developed, attains a thickness of eight hundred or a thousand feet in this State. Only about two hundred and fifty feet of the lower portion of the Coal Measures are found in this county, which may be illustrated by the following section, showing the general arrangement and comparative thickness of the strata:

10 to 15 feet.	Brown sandy shale.
3 to 6 feet	Compact gray limestone.
2 to 4 feet.	Bituminous shale, with concretions of limestone.
	Coal seam No. 4.
8 to 10 feet.	Fire clay and septaria.
60 to 80 feet.	Sandstone and shale.
2 to 6 feet.	Bluish gray arenaceous limestone.
4 to 8 feet.	Bituminous and argillaceous shales.
	Coal seam No. 3.
12 to 15 feet.	Sandy and argillaceous shales.
4 to 6 feet.	Gray limestone.
15 to 30 feet.	Sandy and argillaceous shales.
	Coal seam No. 2.
30 to 40 feet.	Sandstone and shale.
	Coal seam No. 1.
1 to 3 feet.	Fire clay.
15 to 25 feet.	Sandy shale and conglomerate sandstone.

The beds comprising the upper part of the foregoing section, are found well exposed in the vicinity of Rushville, and also on a small branch, which heads near Pleasant View, and runs eastwardly into Sugar creek. They enclose coal seam No. 4, one of the most persistent and valuable in the Illinois Coal Field, which outcrops in the vicinity of Pleasant View, and from thence trends northwestwardly to Rushville, underlying an elevated plateau around and between these points, that forms the water shed between the tributaries of Crooked creek and Sugar creek. The seam ranges in thickness from four to six feet, and in this county averages about five feet. The roof is generally a bituminous shale, which often contains large nodules of dark blue or black limestone, filled with marine shells, among which are *Productus muricatus*, *Clinopistha radiata*, *Pleurophorus soleniformis*, *P. radiatus*, *Cardiomorpha Missouriensis*, *Discina nitida*, *Schizodus curtus*, etc. Above the black shale, there is usually a bed of bluish gray limestone, containing joints of crinoidea, and a few small brachiopods, among which the *Spirifer lineatus*, and a small variety of *Athyris subtilita*, are the most common. The shale and limestone forms an admirable roof to the coal seam, so that it can be worked with perfect safety, and in the most economical manner. Below the coal, there is usually, first, a thin bed of shaly clay, and then a bed of septaria, from two to four feet thick. Messrs. M. Farwell & Co., have been mining this coal in the vicinity of Pleasant View, for many years, for the supply of steamboats at Frederick four miles distant, on the Illinois river. It was first worked by tunneling into the hill where the coal outcrops, on the breaks of a small stream running into Sugar creek, but is now worked mainly by shafts sunk from the general surface level down to the coal. I am indebted to Mr. J. Watson Webb, assistant engineer on the Rock Island and St. Louis railroad, for the following elevations:

	FEET.
Hight of the coal seam at Pleasant View, above the high water level of 1844	190
Above the river bank, opposite Beardstown	202

This seam has so great an elevation, that it will probably be found underlying only the highest lands forming the water shed already mentioned, and consequently, extending over only a limited area in the southern part of township 2 north, range 1 west, and the eastern portion of 2 north, 2 west.

In the vicinity of Rushville, this seam has been worked for many years, and on my first visit to the county in 1854, I found it opened about a mile northeast of the town, where the seam outcrops in a small ravine, on the land of Mr. Rose. Subsequently, this coal has been worked at various points in this vicinity, and during the past year, a shaft has been sunk about a mile northeast of Rushville, and the coal was found at the depth of twenty-five feet. The coal presents the same general character here as in the vicinity of Pleasant View, and the business of coal mining has been greatly extended, since the completion of the Rock Island and St. Louis railroad to this point. The seam has a good slate and limestone roof, and is underlaid by clay shale and septaria, below which there is a thick bed of argillaceous and sandy shales, passing into sandstone. Following down the creek, which runs northwardly from this point into Crooked creek, the strata are found well exposed down to the horizon of coal No. 3, which lies nearly, or quite, a hundred feet below. At this point, the beds between these coals are more argillaceous than we found them north of Rushville, or in the vicinity of Pleasant View, and showed the following succession of strata, downward from coal No. 4:

	FEET.
Fire clay and shale, with septaria	8 to 10
Clay shale	25 " 30
Sandy shales	30 " 40
Thin bedded concretionary sandstone	8 " 10
Bluish gray calcareous sandstone	2 " 3
Clay shale	2 " 3
Black shale	3 " 4
Coal No. 3	2 " 3

The lower coal at this locality, is reported to be 2½ feet in thickness, but the opening had been filled up, so that we could not obtain an accurate measurement of it at this point. The calcareous sandstone over this coal, contains joints of crinoidea, and the overlying concretionary sandstone contains fragments of plants, among which were many broad, ribbon-like leaves of *Cordaites*. Near Oakland Station, on Sugar creek, ten miles northeast of Rushville, No. 3 is found outcropping at several points at the base of the hills. It averages here about three feet in thickness, with a roof of shale and sandstone. The limestone which often intervenes between this seam and No. 2, was seen outcropping below the coal exposed here, but the underlying coal being below the creek valley, was not seen.

Northeast of Pleasant View, a good exposure of all the beds, down to the horizon of No. 2 coal, may be seen on the small stream running northwardly into Sugar creek, and the following is the order of succession here, below coal No 4:

		FEET.
Coal No. 4		4 to 5
Clay shale and septaria		8 " 10
Sandstone and shale		116
Hard bluish gray limestone		8 " 10
Black shale, with concretions of dark blue limestone		4 " 6
Blue shale, with streaks of coal (No. 3)		2 " 3
Sandy and argillaceous shales		56
Coal	No. 2 coal.	2
Clay shale		3
Coal		2 " 3
Fire clay and clay shale		20 " 25

By the foregoing section it will be seen that the strata intervening between coals 3 and 4 are mainly sandstones and sandy shales, and the same is true at some other localities, and a portion of this sandstone is a very good freestone, and has been used for the construction of the jail in Rushville, and for foundation walls in the town and in the adjacent region. This sandstone is well exposed on the breaks of the streams north of Rushville, and affords nearly all the building stone used in this part of the county. Coal No. 3 is not so regular in its development as either No. 4 above it, or No. 2 below, and is frequently replaced by bituminous shales. It is worked, however, at several localities in this county, where it ranges from two to four feet in thickness. On Coal creek, about a mile and a-half southwest of Frederick, tunnels have been opened in this seam along its line of outcrop, where the coal ranges from two to three feet in thickness, but is hardly equal in quality to that from the seam above. A section on this creek, shows all the beds at the base of the Coal Measures, from the horizon of No. 3 coal, down to the Lower Carboniferous limestones, as follows:

	FEET.
Soft yellow limestone	2
Bituminous shale	2
Coal, No. 3	2 to 3
Shale	12 " 15
Hard bluish gray limestone	4 " 6
Clay shale	15 " 18
Coal No. 2	1½
Blue and green sandy shales	20 " 25
Hard calcareous sandstone	10 " 12
Ferruginous shales	6
Calcareous shale with fossils	3
Blue and gray shale	10 " 12
Shaly sandstone	3 " 4

At this point coal No. 2 is too thin to be worked, and No. 1 is wanting altogether, its place being below the three foot bed of calcareous shale, which contains several of the same species of fossils found in connection with coal No. 1, in Fulton county. At Spillar's mine, a mile and a-half above Frederick, No. 3 ranges from 30 to 36 inches in thickness, and the coal appears to be decidedly better in quality than that obtained from the same seam on Coal creek. A half mile below Spillar's, the gray limestone of the St. Louis group is seen just above the road at the foot of the bluff, and has been quarried to supply a lime kiln at this point. The conglomerate sandstone is not represented here, but the ferruginous shale usually found above No. 1 coal, is found here resting directly upon the limestone.

A half mile above Frederick, all the beds, from coal No. 3 down to the base of the Coal Measures, are exposed in the face of the bluff, but neither of the coals are thick enough at this point to be worked. The following section was made here, commencing at the top of the bluff:

	FEET.	IN.
Sand stone	10	
Buff-colored, thin bedded limestone	4 to 6	
Shale	12	
Bituminous shale, (Coal No. 3,)	2 " 3	
Shale	42	
Thin coal, No. 2	0	6
Fire clay and shale	20	
Thin coal, No. 1	0	6
Fire clay, shale and iron ore		6
Sandstone		6

This is the only locality that we met with in the Coal Measures of this county, where one or more of these coal seams was not developed of sufficient thickness to be worked, but there may be other points also, where the coal is either absent altogether, or replaced with bituminous shale.

At the place formerly owned by Mr. James A. Chadsey, on section 32, township 2 north, range 1 east, there are two bands of iron ore in the shale below coal No. 2, that will afford a very good ore for the manufacture of metallic iron. These bands of iron ore occur just above the horizon of No. 1 coal, which is not developed here, and they are respectively 12 and 6 inches in thickness, separated by about two feet of shale. The section at this locality is as follows:

		FT.	IN.
Massive sandstone		30 to 40	
Silicious limestone		3 " 4	
Bituminous shale, (Coal No. 3,)		3 " 5	
Shale		27	
Hard gray limestone		6	
Shale		14	
Brash coal,	Coal No. 2.	1	
Shale,		2	
Coal,		2	
Shale and sandstone		12	
Iron ore		1	
Shale		2	
Iron ore		0	6
Shale, with thin bands of iron ore		6	
Sandstone and streaks of coal, (No. 1,)		18	
Hard gray limestone, of the St. Louis group		10	

A little west of Chadsey's place, coal No. 2 has been worked by Mr. John Rebman, where the seam is three feet thick, according to the report of those living near, but the roof had fallen in so that it could not be measured when we were at the locality. It is probable that the parting of shale, which separates this coal in the foregoing section, has thinned out here so that the two divisions form but one seam. On the same branch, a little higher up, the bituminous shale of coal No. 3 is about three feet thick, underlaid by a few inches of impure coal. The shale contains large concretions of dark blue arenaceous limestone, containing fossil shells, among which were *Aviculopecten rectalaterarea*, *Cardiomorpha Missouriensis*, two or three species of small *Goniatites*, *Productus Prattenanus* and *Chonetes mesoloba*. The hard gray limestone which intervenes between these coal seams, at Chadsey's place, and at many other points in this county, was wanting here. It is usually from four to six feet thick, and more or less concretionary in structure, and resembles, in its lithological characters, the concretionary member of the St. Louis group, but may always be distinguished by its fossils, which consist of two or three species of *Naticopsis*, *Spirifer lineatus*, *Pleurotimaria sphærulata* and *Athyris subtilita*.

The lower division of the Coal Measures, embracing the horizon of the three lower coal seams, underlies nearly all the highlands in the central and eastern portions of this county, and are found outcropping on all the principal streams and their tributaries. In the western part of the county, on Crooked creek, and the region lying west of that stream, the beds rise so that the Lower Carboniferous limestone, and the conglomerate sandstone, form the principal outcrops in the bluffs of the creek, while only a few feet in thickness of the lower portion of the Coal Measures, sometimes including coal No. 2, are found underlying the adjacent highlands. It is not probable that any coal, except No. 2, will be found west of Crooked creek, of sufficient thickness to be of any economical importance.

The upper seam developed in this county, or No. 4 of the general section, is found in the vicinity of Rushville and Pleasant View, and is by far the most valuable coal in the county, and will furnish an abundant supply of coal, sufficient to answer all the demands of the region adjacent to its outcrop, for many years. Its position in the series, is about one hundred and seventy-five feet above the base of the Coal Measures, and consequently, it is only found underlying the most elevated portion of the county, comprising a belt of country from two to four miles in width, extending northwesterly from Pleasant View to a point a few miles northwest of Rushville, where the surface level gradually slopes away towards Crooked creek, and soon sinks below the level of this coal. No deep mining will be necessary to reach this seam, for if found at all, it will be at a depth varying from fifty to seventy-five feet, or less, below the surface, and it is found outcropping on the head-waters of several of the small streams, that serve to drain the elevated region which it underlies. The seams below this are generally too thin to be worked at the present time, except along their outcrop, where tunnels can be driven into them, and the coal taken out without the expense of sinking a shaft down to the coal, through the overlying strata.

Nos. 2 and 3 vary in thickness from two to three feet, while No. 1 was not met with in the county sufficiently developed to be of any economical value.

St. Louis Group.—The outcrop of the Lower Carboniferous limestones in this county, is restricted to the valleys of the principal streams, and to the Illinois river bluffs, between the mouth of Sugar creek and the south line of the county. The St. Louis group, which comprises the upper division of the series, consists of a gray concretionary limestone of variable thickness, ranging from five to twenty feet, forming the upper member of the group, below which we find a brown magnesian limestone, sometimes quite massive, and in regular beds, and at other localities, intercalated with shales, or passing into a thin bedded or shaly limestone.

The concretionary limestone is not very regular in its development, but often occurs in isolated patches or outliers, and is a rough gray limestone, presenting no regular lines of bedding, but usually concretionary or brecciated in its structure. It outcrops at intervals, along the bluffs of Crooked creek, through its whole course in this county, and also along the bluffs of the Illinois river, as far north as the vicinity of Browning, where it disappears. It was also found on Sugar creek, as far up as McKee's mill, on section 17, township 2 north, range 1 east. The only fossils that were obtained from this limestone, was the *Lithostrotion canadense*, a silicious coral that abounds in it almost everywhere, and is found weathered out in the beds of the streams, in masses, often of considerable size, which, from the polygonal form of the single corallites that go to form the mass, are often called *petrified honey comb.* In the vicinity of Birmingham, we found this limestone eighteen feet thick, and overlaid by the conglomerate sandstone of the Coal Measures. It is underlaid by a bed of calcareous sandstone, and also a magnesian limestone about ten feet thick, which forms the base of the St. Louis group at this locality.

The magnesian limestone is far more regular in its development than the concretionary limestone, and is usually of a rusty brown color on the surface, from the oxydation of the iron which it contains. It contains a few species of fossils, among which are *Productus Altonensis*, *Archimedes Wortheni*, *Spirifer Keokuk*, *Rhynchonella mutata*, and a large *Conularia*, perhaps *C. Missouriensis* of Swallow. This limestone occurs at the base of the bluff at Frederick, and also in the vicinity of Schuyler City, which is the most northerly point where we found it exposed in the river bluffs.

Keokuk Group.—Only the upper portion of this group is exposed in this county, and its greatest development appears to be in the vicinity of Birmingham, in the northwest corner of the county. The greatest thickness exposed here is about fifty feet, of which the lower fifteen feet is a thin bedded limestone, containing many of the characteristic fossils of this group, above which there is about thirty-five feet of calcareo-argillaceous shales, containing geodes of quartz and chalcedony. The easterly dip of the strata is considerably more than the fall of the creek in that direction, and these beds dip below the bed of the creek, before it strikes the north line of Brown county. The thin bedded limestones which occur at the base of the section near Birmingham, contain many of the characteristic fossils of this group, among which are *Archimedes Owenana*, *Productus punctatus*, *Agaricocrinus Americanus*, *Platycrinus Saffordi*, *Spirifer Keokuk*, and *S. neglectus*. The geodiferous shales above, contain the common geodes, lined with quartz crystals and mammillary calcedony, and more rarely, crystals of dolomite, calc spar, and zinc blende. The limestones locally intercalated in the shale, contains the same species of fossils that are found in the limestones below.

Economical Geology.

Coal.—The most important and valuable mineral resource of this county consists of the deposits of bituminous coal, which underlie the greater portion of its surface, and especially that portion of the county lying west of Crooked creek. Until quite recently, the coal of this county has had no outlet to market, except as it was required for home consumption, but since the completion of the railroad to Rushville, and its probable extension, at an early day, into and through a region further south, which is but poorly supplied with coal, a ready market will be found for all the coal of this county. The upper seam is the most valuable, and, from its greater thickness and excellent roof, can be mined more economically than either of the lower seams. Its average thickness is nearly five feet, and its product about five million of tons to the square mile. It affords a hard, bright coal, which breaks with a conchoidal fracture, and is traversed by vertical seams of carbonate of lime, which are often stained with the oxyd of iron. The following analysis of a specimen of this coal, from the mines near Pleasant View, by Mr. Henry Pratten, former chemist and assistant in the Geological Survey of Illinois, is reported in Norwood's "Abstract of a Report on Illinois Coals," page 24:

Specific gravity	1.286		
Loss in coking		40.60	
Total weight of coke		59.40	
			100.00
Analysis: Moisture	6.0		
Volatile matters	34.6		
Carbon in coke	52.9		
Ashes (deep red)	6.5		
		100.00	
Carbon in coal	57.8		

Another analysis of a specimen from Rose's coal bank, near Rushville, from the same report, is as follows, and is interesting, as showing the variable character of the coals from the same seam at different localities:

Specific gravity	1.303	
Loss in coking		41.6
Total weight of coke		58.4
		100.00
Analysis: Moisture	4.5	
Volatile matters	37.1	
Carbon in coke	46.1	
Ashes, (white)	12.3	
		100.00
Carbon in coal	51.79	

The two lower seams, ranging from two to three feet in thickness, are not so extensively worked at the present time as the one above mentioned, but as they underlie a far greater extent of surface than the upper seam, they will, no doubt, furnish by far the greatest amount of coal in the aggregate. No. 3 is worked by Mr. Spillar, about a mile above Frederick, and affords an excellent coal, containing less of the bi-sulphuret of iron than the coal from the upper seam. No. 2 is often divided by a parting of clay shale, and the divisions are then usually too thin to be worked, but at other localities, it forms a solid seam from too to three feet thick. One or both of these seams will be found underlying the greater portion of the uplands north and east of Crooked creek, and accessible at many points in the county, remote from the outcrop of the upper seam, and their value and importance will be eventually appreciated, as population increases, and the demand for coal for mechanical and manufacturing purposes becomes more imperative.

Clays.—Clays suitable for fire brick and for the manufacture of pottery, are usually abundant in the lower portion of the Coal Measures, and the bed of clay shale below coal No. 2, which is used for this purpose at Ripley, in Brown county, is also found here. We found an exposure of it on the place formerly owned by Mr. James A. Chadsey, on Sugar creek, where it presented the same general appearance as at Ripley, and appeared to be equally well adapted to the manufacture of potter's ware. At the coal bank of McKee and Chadsey, on the head-waters of McKee's creek, north of Rushville, there is a bed of excellent fire clay under the upper coal seam, from four to six feet thick. This may be only a local development, however, as at all the other localities in the county where we saw this under-clay exposed, it partook more of the character of a clay shale, and was also rather too thin to be of any economical value. The fire clay below coal No. 2, is usually of a good quality, and may be profitably worked in connection with the coal, when it is two feet or more in thickness. Wherever a seam of good fire clay occurs with these lower coals, it will add materially to their value, enabling the miner to drift more economically for both together, than he could do for the coal alone.

Iron Ore.—Iron, either in the form of a carbonate or sulphuret, is very generally distributed through the Coal Measures, and the latter is almost always found more or less in the coal itself, thereby greatly deteriorating its value. A very good argillaceous iron ore occurs on Sugar creek, on the place formerly owned by Mr. James A. Chadsey, on section 32, township 2 north, range 1 east, intercalated in the shale below No. 2 coal. It occurs in several bands, the thickest one being a foot in thickness, the next in importance, about six inches, and then some thinner ones, making altogether, an aggregate of about two feet in thickness of iron ore, distributed through some five or six feet of shale. An analysis of this ore by Messrs. Blaney and Mariner, of Chicago, is given in this place, and also, for comparison, the analysis of a similar ore from Pennsylvania:

Analysis of Chadsey's iron ore:

Protoxide of iron	52.31
Lime	1.16
Magnesia	1.48
Silica	8.84
Alumina	10.44
Water and carbonic acid	25.77
	100.00

Analysis of argillaceous iron ore from Pennsylvania, as determined by Prof. H. D. Rodgers:

Peroxide of iron	.23
Protoxide of iron	53.03
Lime	3.33
Magnesia	1.77
Silica	1.40
Alumina	.63
Water, carbonic acid, and bitumen	39.61
	100.00

In regard to the Schuyler county ore, Messrs. Blaney and Mariner remark as follows: "The Chadsey iron ore is an argillaceous carbonate of iron, of excellent quality, comparing favorably with the Pennsylvania ores, the analysis of one of the best of which is given for comparison." There is no question as to the good quality of this ore from Schuyler county, and the only point that remains to be determined is, whether it can be found in a sufficient body to justify the erection of an iron furnace in this vicinity. Iron ore of similar quality, is found at about the same horizon, at several localities in this and the adjoining counties, but nowhere in large bodies.

Building Stone.—Good building stone is tolerably abundant in this county, and is accessible on nearly all the streams. The sandstones below the main coal seam, furnishes a free-stone of good quality, which has been used in the construction of the jail in Rushville. The strata vary in thickness from one to three feet, and the rock is even textured, and is easily cut and dressed, and is used for caps and sills, as well as for foundation walls, and all the ordinary purposes for which a building stone is required. It outcrops on McKee's creek, north of Rushville, and also on the small branch running east from Pleasant View into Sugar creek.

The brown magnesian limestone of the St. Louis group, furnishes the best material for culverts, bridge abutments and similar purposes, where the rock is required to withstand the combined influence of frost and moisture. It outcrops along the bluffs of Crooked creek, through its whole extent in this county, and also in the bluffs of the Illinois river, as far north as Frederick.

The Keokuk limestone, underlying the geodiferous shales of that group, afford some good building stone, but its outcrop is limited to the bed of Crooked creek, in the northwest part of the county. At the best exposures, which were found in the vicinity of Birmingham, the rock was rather thin bedded and cherty, but this was on the exposed outcrop of the bed, where the strata had been split into thin layers by the combined influence of frost and moisture. If quarries were opened in this rock, extending back beyond the influence of atmospheric agencies, it would be found to improve in quality. For caps and sills, where a handsome cut stone is desired, this bed will afford the best material for that purpose, that can be found in this county.

Limestone for Lime.—The concretionary gray limestone, which forms the upper division of the St. Louis group, furnishes the best limestone for the manufacture of quick lime to be found in this portion of the State, and it may be found in the bluffs of Crooked creek, through nearly its whole course, and at intervals, along the bluffs of the Illinois river, as far north as Browning.

At Birmingham, this limestone is eighteen feet in thickness, which is, however, considerable more than it will average, but it is usually from eight to ten feet, and it will furnish an abundance of limestone to supply the demand for lime in this county, for all time to come. A fair article of lime may also be made from the Keokuk limestone, but where the other is accessible, it is always to be preferred.

The limestone over the upper coal seam, in the vicinity of Rushville, has also been used for this purpose, but it does not appear to slack readily after burning, and would, probably, make a dark colored lime. The abundant supply of both wood and coal in this county, will justify the manufacture of lime on as large a scale as the wants of the adjacent region shall demand.

Sand and Clay, for brick making, are abundant in all parts of the county, and may be readily obtained at nearly every locality where the manufacture of common brick is desirable. The brown clay, forming the sub-soil over a large portion of the surface, answers a good purpose for brick making, and sand is abundant in the valleys of the streams, and in the eastern portion of the county, in the Loess which caps the river bluffs.

Mineral. Springs.—A sample of mineral water was sent to me from this county, the locality of the spring not given, which was sent to Dr. Blaney for analysis, and the following is his report: "Has an acid reaction, a strong styptic taste, a trace of organic matter, and an obscure trace of chlorides. The residue, after evaporation to dryness, does not give efflorescence with acids. A wine gallon (231 cubic inches), by direct determination, gives a residue 156 28-1000 grains of solid matter, which consists of—

Sulphate of lime	73.936
" magnesia	2.982
Proto-sulphate of iron	69.959
Silica	1.315
Alkaline sulphates	7.836
	156.028"

CHAPTER VI.

FULTON COUNTY.

This county contains a superficial area of about twenty-four townships, or eight hundred and sixty-four square miles. It is triangular in shape, and is bounded on the north by Knox and Peoria counties, on the east by Peoria county and the Illinois river, on the south by Schuyler county, and on the west by Schuyler, McDonough and Warren counties.

The principal streams in the county are the Illinois river, forming its main boundary on the east and southeast for a distance of about thirty miles; Spoon river and its tributaries, which traverse nearly the whole extent of the county, from north to south, and Copperas creek, which drains a considerable area in the northeastern portion of the county. These streams drain the whole area of the county, and their valleys are from one hundred and fifty to two hundred feet below the general level of the adjacent highlands.

The surface was originally nearly equally divided into prairie and timbered lands, the former occupying the most elevated positions of the county, as well as a part of the Illinois river bottoms, while the timber belts are mainly restricted to the more broken lands skirting the water courses. Much of the original timber, however, has been cleared away in developing the agricultural interests of the county, and splendid farms now occupy a large portion of the area which, but a few years since, was covered with a dense forest. Much of the upland was originally timbered with a dense growth of sugar-maple, black walnut, linden, hackberry, elm, honey-locust and wild-cherry, indicating a very rich and productive soil. This growth of timber usually prevails where the Loess overlies the drift clays on a tolerably level surface, and these lands, in their productive qualities, are second to none in the State. Where the surface is broken into sharp ridges, along the borders of the smaller streams, black and white oak, and hickory is the prevailing timber, and the soil is a thin chocolate colored, or brown, clay loam, well adapted to the growth of small grain, clover or fruit. The prairies in this county generally have a rolling surface, though, in the region about Fairview, there are some quite flat prairies that require draining in wet seasons. The soil on the prairies is a dark brown or black mould, varying from one to three feet in depth, with a sub-soil of brown clay loam.

The bottom lands, on the western bank of the Illinois river in this county, are from one to four miles in width, and are mostly covered with timber, though there is some bottom prairie near the mouth of Spoon river. A good deal of this bottom land is too low and marshy for cultivation, but where it is sufficiently elevated, the soil is a rich sandy loam, and very productive. The bluffs generally range from one hundred and twenty-five to one hundred and fifty feet in height, and are usually cut into sharp ridges by the valleys of the small streams that drain the adjacent region. The lower part of these bluffs, to the height of seventy-five to one hundred feet, consist of the stratified rocks of the Coal Measures into which the original valley was excavated, and their elevation has been subsequently increased by the accumulation of Drift clays and lacustrine deposits upon them. The valley of Spoon river seldom exceeds a mile in width, and is excavated into the Lower Carboniferous limestone on that part of its course, extending from Seaville to Bernadotte. The depth of this valley is about the same as that of the Illinois river, but the lower rocks are reached here, in consequence of the easterly dip of the strata, which brings the limestones nearer to the surface in the western portion of the county.

Surface Geology.

The surface deposits of Fulton county consist of Drift clays and gravel, with the subsequent lacustrine and alluvial accumulations. The Drift proper, ranges in thickness from thirty to sixty feet, or more, and is usually composed of brown and bluish colored clays with gravel, and boulders of metamorphic and igneous rocks, varying in size from a pebble to masses of several tons weight. Usually, the brown clays constitute the upper portion of the deposit, and the blue clays the lower. In the vicinity of Utica, a bed of ferruginous conglomerate, about two feet in thickness, underlies the Drift clays, and similar beds, in local outliers, have been met with in the same position, at several localities in the State. This conglomerate exactly resembles the bed at Metropolis, in Massac county, on the Ohio river, which has been usually referred to the Tertiary period, and may be of the same age.

On the west side of Big creek bridge, near Canton, in grading the track for the T. P. & W. railroad, a band of black mould or soil, containing leaves and fragments of wood, was found below the Drift clays, which is, no doubt, a part of the ancient soil covering the surface anterior to the Drift epoch. A similar bed has been found in sinking shafts and wells in various parts of the State, indicating the prevalence of dry land over a considerable portion of the present area of the State, during the Post-tertiary period. Mr. John Wolf, of Canton, reports a similar bed of black peaty soil, four feet in thickness, underlying the town of Fairview, at the depth of eleven feet. The heaviest deposits of Drift occur along the Illinois river bluffs, and in the vicinity of Lewiston, where the beds range from forty to sixty feet in thickness, while in the central and western portions of the county, their general range is from thirty to forty feet.

The Loess caps the bluffs of the Illinois river, and extends back for three or four miles, with a constantly diminishing thickness, towards the interior of the county. This deposit consists of buff, or light brown, loamy sand, imperfectly stratified, and locally contains an abundance of land and fresh water shells, such as now accumulate at the bottom of fresh water ponds. Its presence in the river bluffs is often indicated by bald, grassy knobs, which prevail more or less wherever this formation is extensively developed. It is always unconformable with the underlying deposits, and presents its greatest thickness immediately at the river bluffs, thinning out rapidly towards the interior of the adjacent region. Where it forms the sub-soil, and is overlaid by a loamy clay soil, we find the heaviest growth of upland timber, such as sugar-maple, linden, wild-cherry, black walnut and elm, and the lands, when reduced to cultivation, are among the most productive in the State. This is the character of some of the timbered lands in the vicinity of Lewiston, and at some other points in the county adjacent to the river bluffs. When this formation was deposited, the valley of the Illinois, as well as that of most of our large rivers, was a vast fresh water lake, into which the sandy material that constitutes the greater part of this formation was transported by the action of the rains, and streams of running water that drained the adjacent highlands. The fossils which it contains, are mostly of the same species of land and fresh water shells that now inhabit the adjacent region, but occasionally the remains of the Mammoth, Mastodon, Megalonyx, and some other extinct mammalia have been found in it in this State.

Older Geological Formations.

The stratified rocks of this county belong, mainly, to the Coal Measures, with a limited exposure of the St. Louis limestone in the valley of Spoon river. Nearly all the uplands in the county are underlaid by coal, and we have found here the most complete exposure of the productive Coal Measures that have been met with in the State, and hence the section constructed in this county will be considered a typical one, and will be used for the co-ordination of the coal strata throughout the central and western portions of the State. We have found here seven consecutive seams, all exposed by their natural outcrop, within the county, and all, except the upper one, have been worked to a greater or less extent. The aggregate thickness of these seams is about twenty-five feet, and their individual range is from twenty inches to six feet in thickness. The three lower seams outcrop in the southern and western portions of the county, especially along the bluffs of Spoon river, and as the general dip of the strata is to the eastward, they pass below the level of the Illinois river, and are, therefore, not seen on the eastern borders of the county. The upper seams underlie nearly all the central and eastern portions of the county, and one of them, No. 4, is found south of Spoon river, underlying the high lands in the vicinity of Astoria. The following section, compiled from careful measurements made at the outcrops seen in various portions of the county, will show the relative position of these coals with each other, and the character and thickness of the strata with which they are associated :

Section of the Coal Measures in Fulton County:

4 to 6 feet.	Thin bedded gray limestone.
15 to 20 feet.	Shales but partially exposed.
▬	Coal seam No. 7.
37 feet.	Shale and shaly sandstone.
3 to 5 feet.	Argillaceous limestone and bituminous shale,
▤	Coal seam No. 6.
5 to 10 feet.	Fire clay and nodular limestone.
15 to 20 feet.	Sandstone and shale.
2 to 8 feet	Black shale and nodules of limestone.
▤	Coal seam No. 5.
25 to 30 feet.	Sandy and argillaceous shales.
2 to 6 feet.	Bituminous shale and limestone.
▤	Coal seam No. 4.
3 to 6 feet.	Clay shale and septaria.
60 to 80 feet.	Sandstones and sandy shales.

2 to 6 feet.	Dark blue silicious limestone.
3 to 4 feet.	Black shale.
■	Coal seam No. 3.
30 to 40 feet.	Argillaceous and sandy shales and sandstone.
■	Coal seam No. 2.
40 to 60 feet.	Sandstone and shale.
3 to 6 feet.	Bituminous limestone and band of iron ore.
1 to 6 feet.	Bituminous shale.
■	Coal seam No. 1.
2 to 3 feet.	Clay shale or fire clay.
20 to 30 feet.	Conglomerate sandstone and shale.

These coals we have numbered from the bottom upward, and they will be described in the same order. The only point in the county where we found No. 1 sufficiently developed to be worked profitably, is in the vicinity of Seaville, on the west side of Spoon river, at the crossing of the T. P. & W. railroad. The seam is worked here at two localities, one above the railroad bridge and the other below. At these mines, the coal averages about three feet in thickness, and is mined by tunneling into the bluff on the outcrop of the seam. About a hundred yards to the westward of Mr. Harris's mine, below Seaville Station, the seam is divided by a parting of shale, which soon thickens to the westward, to three or four feet, and thus destroys the value of the seam for mining. The roof consists of a bituminous shale, that ranges in thickness from one to six feet, above which there is a bed of blue argillaceous limestone, from three to six feet thick, forming, altogether, an excellent roof to the coal.

The limestone at this locality, has afforded an interesting group of fossils, several of which have hitherto been considered as especially characteristic of the upper coals. We obtained the following species at this locality: *Athyris subtilita*, *Retzia punctilifera*, *Spirifer cameratus*, *S. Kentuckensis*, *S. opimus*, *Productus Prattenanus*, *P. nana*, *P. punctatus*, *Orthis carbonaria*, *Terebratula* *bovidens*, *Schizodus Alpinus*, *S. amplus*, *Macrocheilus inhabilis*, *Eupachycrinus tuberculatus*, or a closely allied species, *Zeacrinus mucrospinus*, and several undetermined species of *Bryozoa*. This group of fossils, if found in connection with a coal, the position of which could not be determined from the associated strata, would certainly be considered as strongly indicating an upper coal horizon, and their occurrence here at the very base of the Coal Measures, shows that many species at least, of the fauna of the carboniferous epoch, range through the whole extent of the coal-bearing strata.

We also found this seam well exposed in the cuts of the C. B. & Q. railroad, through the bluffs on the north side of Spoon river, below Lewiston. It is divided here by a parting of shale, which leaves both divisions of the seam too thin to be of any practical value for mining, as the average thickness of the two divisions ranges from six to twelve inches only, and they are too widely separated at this point to be mined together. In the vicinity of Bernadotte, a good section of the lower coals may be seen in the bluffs of Spoon river, but the horizon of No. 1 coal was only indicated by a bed of bituminous shale, four feet in thickness.

The following section was made near Bernadotte:

	FEET.	IN.
Shale and sandstone	38	
Coal No. 2?	2	6
Fire clay	3	
Arenaceous limestone	1	
Clay shale	4	
Bituminous shale	1	3
Clay shale	4	
Band of septaria	1	
Shale and sandstone	10	
Bituminous slate	1	6
Sandstone and shale	24	
Bituminous shale (Coal No. 1?)	4	
Clay shale with iron ore	5 to 6	
Sandstone and shale	15 " 20	
St. Louis limestone	6	

No. 1 coal is probably represented in the above section by the lower bed of bituminous shale, and we find two additional seams of bituminous shale below the upper coal in this section that are not found at Seaville. Nevertheless, there can be no doubt of the equivalency of the strata at these localities, as at both, the sandstane at the base of the section rests directly upon the St. Louis limestone.

In the vicinity of Avon, in the northwest corner of the county, a seam of cannel coal occurs, occupying, apparently, about the same horizon as the lower bed of bituminous shale in the foregoing section, though, from the imperfect exposure of the strata associated with it, its exact position could not be accurately determined. The seam is here only about 14 to 20 inches in thickness, and was extensively worked at the time of our first visit to the county, in 1859, for the distillation of coal oil. Ten retorts were then in operation at this locality, and the product was said to be thirty gallons of oil from a ton of coal. However, the development of the oil wells of Pennsylvania, shortly afterwards, put a stop to the manufacture of oil from cannel coals in this State, and the mines were abandoned. This seam is underlaid here by about five feet of excellent fire clay, which was worked at that time in connection with the coal, and used in the manufacture of fire brick. About a quarter of a mile from this exposure, on the other side of the hill, a two foot seam of bituminous coal is seen, overlaid by two feet of dark blue bituminous limestone, exactly like that above coal No. 1, at Seaville. The seam of cannel coal is probably the lower division of No. 1, or a local development of another seam, occupying nearly the same horizon.

On Swan creek, one mile north of Avon, the following beds are exposed:

	FEET.	IN.
Sandy shales	16	
Coal	0	10
Fire clay and shale	20	
Band of iron ore	0	10
Bituminous shale	5	
Sandstone	10	

The band of iron ore in the above section resembles very closely that at Chadsey's place, in Schuyler county, and at Seaville, in this county, above coal No. 1, and probably occupies the same horizon. If so, it shows a very irregular development of the lower coal in this vicinity, and it is probable that this seam is the least reliable of all the coals in this county, except No. 5, hereafter to be mentioned.

Coal No. 2 is one of the most regular seams in the whole series, and usually ranges from two to three feet in thickness. It will be found everywhere in the bluffs of Spoon river, where the strata are well exposed, and its stratigraphical position is generally about forty or fifty feet above the horizon of No. 1, although, in the vicinity of Seaville, the distance intervening between them is about seventy feet. The roof is almost invariably a blue clay shale, and in tunneling it requires to be thoroughly cribbed to prevent the falling of the roof. In the south part of the county, this seam outcrops on Otter creek, about a mile and a half west of Vermont, where it has been worked since the earliest settlement of the county. It ranges in thickness from two and a-half to three feet, in this vicinity, and outcrops along the bluffs of the creek for a distance of three or four miles. A boring for oil was made in the valley of this creek, commencing just below the horizon of No. 2, and extending to the depth of about eight hundred feet, but unfortunately no journal was kept of the different strata passed through. The Lower Carboniferous limestone was reached at a depth of about sixty feet, as we learned from Mr. Matthewson, who made the boring, and he also stated that no coal was passed through in the boring, which would indicate that there was no development of coal No. 1 at this point.

In the bluffs of Spoon river, south of Lewiston, as well as on some of the small tributaries of that stream in the same vicinity, No. 2 is worked at many points, and about a mile west of the city, at one or two of the localities examined, the roof was found to be slightly calcareous, and contained several species of fossil shells, among which we observed *Lingula umbonata*, *Productus Prattenanus*, *P. muricatus*, *Macrŏcheilus*, *Nautilus*, etc. A half mile east of Lewiston, this seam has been opened by a shaft forty feet in depth, on the lands of Mr. Hunter. This shaft is situated in the valley of a small stream, and about sixty feet below the level on which the city is built. Two miles and a-half southeast of Lewiston, we found a mine opened in this seam, on the lands of Mr. Wm. Winterbottom, on our first visit to the county, in 1859, and at the same time it had been opened a mile nearer to the town, by Mr. Butler. At both these localities, the coal varies from two and a-half to three feet in thickness, and is overlaid by blue shale and sandstone.

In the vicinity of Bernadotte, this coal is found at an elevation of about eighty feet above the river level, and the coal was mined by Mr. Parks, one mile and a-half southwest of the village, in 1859. In the vicinity of Seaville this seam has been opened on Mr. Harris's place, a little south of the school house, where the coal has been worked in open trenches, by throwing off the overlying shale. In the vicinity of Avon, it was not met with, unless it is represented by the ten-inch seam near the top of the section, on Swan creek. No. 2 usually affords a coal of excellent quality, freer from the bi-sulphuret of iron than the average of Illinois coals, and one that cokes well, and contains more than an average per cent. of fixed carbon. An analysis of this coal will be found further on.

Coal No. 3 has been mined but little in this county, and consequently we know less of its peculiar characters, than of the seams lying either above or below it. It is somewhat irregular in its development, resembling No. 1 in that respect. It usually lies from forty to sixty feet above No. 2, but in the bluffs of Spoon river, near Seaville, they are only a little more than twenty feet asunder. It is almost invariably overlaid by black slate, and a dark blue or bluish gray silicious limestone, which contains *Aviculopecten rectalaterarea*, *Cardiomorpha Missouriensis*, with two or three species of small *Nautili* and *Goniatites*. About two miles southwest of Bryant Station, the limestone and slate above outcrops at the water's edge on Big creek, and, about a quarter of a mile further down the creek, a tunnel has been made into the coal where it was said to be five feet thick, but, from the partial filling up of the opening, we were unable to ascertain its exact thickness. In the vicinity of Marietta, we found a coal seam opened in 1859, on section 12, township 6 north, range 1 east, which we are inclined to believe is this coal, though the seam is here only about two feet six inches in thickness. In the bluff, at Seaville, the blue silicious limestone usually overlying this coal, is found about twenty-five feet above coal No. 2, but there is only a few inches of black shale to represent the coal that belongs below it. In the bed of Coal creek, three miles northwest of Fairview, this coal is found in the bed of the creek. It is here only about eighteen inches in thickness, and is overlaid by about two feet of bituminous shale, above which is the blue silicious limestone about two feet thick, containing the characteristic fossils of this coal. Nodules of septaria, associated with a band of iron ore, occur here, above the limestone. This septaria, has a blue ground, veined with pearl spar, and affords very handsome specimens.

Coal No. 4 is a very persistent seam in its development, and has been found at every locality in the county that we have examined, where the proper horizon for it was exposed. On the south side of Spoon river, it underlies the high lands about Astoria, and we found it opened a half mile northwest of the town in 1859. The seam is here from four and a half to five feet in thickness, and is overlaid by two feet or more of black shale that forms a good roof. Nodules of dark blue limestone occur in the black shale above the coal, filled with the characteristic fossils of this horizon. On the north side of Spoon river, we found this seam outcropping in the bluffs of Big creek, west of Bryant Station, about twenty five feet above the creek valley. The coal had been undermined here, in the excavation of the valley, and a portion of it. with the overlying strata, and covering a considerable area, had fallen down about twenty feet below its original level, and retains its horizontal position so nearly, that we were at first disposed to regard it as the apparent outcrop of two distinct seams, but further investigations showed that all the coal exposed here, probably belonged to the same horizon. The roof shales at this locality contained many large concretions of bituminous limestone, filled with the characteristic fossils of this seam, among which are *Discina nitida*, very abundant, *Productus muricatus*, abundant, *Clinopistha radiata*, *Schizodus curtus?* *Pleurophorus soleniformis*, *P. radiatus*, *Nautilus*, one or more species, and a small *Orthoceras.*

This seam has been more extensively worked by Mr. David Williams, at Canton and St. Davids, than by any other person in this county. His main shaft is about half a mile southwest of Canton, and is about eighty-five feet in depth, passing through the following beds:

	FEET.
Drift clay	30
Sandstone and shale	50

	FEET.
Black slate, with limestone nodules	3
Coal No. 4	5

Below the coal, there is a bed of septaria limestone, from three to four feet, and below that, a fire clay, three or four feet in thickness, passing downward into clay shale. This seam affords a heavy coal, rich in bitumen, and contains from thirty-five to forty per cent. of volatile matters, and from fifty-five to fifty-six per cent. of fixed carbon. At his middle shaft, a little further down on Big creek, the outcrop of coal No. 6 may be seen about sixty-five feet above No. 4, with no indications of the presence of No. 5 at this point. The coal from the two shafts near Canton, finds a market mainly on the line of the T. P. & W. railroad, while that at St. Davids, three miles below, finds a ready market on the Lewiston branch of the C. B. & Q. railroad, now completed from Rushville to Galesburg.

At Breed's Station, on the T. P. & W. railroad, about six miles east of Canton, a tunnel has been opened in this seam, by Mr. J. R. Breed. The coal averages about five feet in thickness at this mine, and has a good roof of black slate, from two and a-half to three feet in thickness. The coals Nos. 5 and 6, or 6 and 7, are said to outcrop in the hills in this vicinity, but have not been opened. The upper two feet of the coal at this mine, appears to be quite free from iron pyrites, and is reputed a good smith's coal. A band of iron ore, resembling "Black Band Ore," was observed in connection with this coal, but apparently too thin to be of any practical importance. This seam outcrops at various points on Copperas creek, and may be conveniently worked by tunnels in the hill sides, or in open trenches, where it underlies the creek valley.

About two miles southeast of Cuba, we found this seam opened in 1859, on the land then owned by Mr. John Winterbottom. The coal at this locality ranges from four and a half to five feet in thickness, and is overlaid by about three feet of black slate, with concretions of argillaceous limestone. This seam affords a coal of good quality, in this vicinity, hard, bright, and generally quite free from iron pyrites. We also saw the outcrop of No. 4, about a mile north of Cuba, where it was found, by measurement, to be thirty-two feet below No. 5. Northwest of Fairview, this seam is worked at several points on the breaks of Coal creek, where it presents its usual thickness and appearance. It may be fairly considered as the most valuable of all the coals outcropping in this county, from its wide extent, and the average quality of the coal which it affords.

No. 5 appears to be quite local in its development, and we found it worked only in the vicinity of Cuba, where it ranges from four to five feet in thickness, but it has also been found at two or three points in the vicinity of Canton, where it occurs in local basins, or "pockets," sometimes attaining a thick-

U OF M

ness of ten or twelve feet, and then thinning out entirely in a distance of a few rods. It affords a softer and lighter coal than that from No. 4, and in this respect, it bears some resemblance to the coal from No. 6. A section of the Cuba coal shaft, including the beds below, down to the horizon of No. 4 coal, is as follows:

	FEET.	IN.
Hard blue limestone	8 to 4	
Black slate	1 " 2	
Coal No. 6	6	
Fire clay	5	
Nodular limestone, with *Chætetes milleporaceous*	4	6
Clay shale.	6	
Limestone	1	6
Sandstone and shale	5	
Limestone	1	
Black shale	9	
Coal No. 5	4 " 5	
Shale	30	
Black slate	2	
Coal, No. 4	5	

In the vicinity of Canton, the horizon of this coal is exposed at many points, where no indication of coal is seen. This is the seam worked in the shaft at Cuba, and it affords a tolerably soft coal, that burns freely and leaves but little clinker.

At Mr. John Williams's place, five miles and a half northeast of Canton, there are two coal seams exposed in the same hill-side, and both are directly overlaid by sandstone. I am inclined to regard them as coals 5 and 6, and they are separated by about thirty feet of sandstone, very similar in its appearance to that usually found overlying No. 6. These coal seams average about four feet and a half in thickness, and the sandstone forms a very good roof. These are the only points in the county where we found No. 5 sufficiently well developed to be of any practical value, though it is quite probable that it may be found elsewhere. It usually lies about midway between coals 4 and 6, or thirty feet above the former, and about the same distance below the latter, and when either of these seams are found, the horizon of No. 5 can readily be determined.

Coal No. 6 is the highest coal in the series that has been worked to any extent in this county, and it affords an excellent coking coal, and also a better smith's coal than is usually obtained from either of the lower seams. On our first visit to this county, in 1859, we found this seam opened at Mr. Piper's place, two miles north of Canton; at Mr. Burton's place, two and a half miles north of Farmington, and it was also worked by Mr. Burbridge at that time, about three miles west of Farmington, on Little's creek. More recently, it has been opened by Mr. Johnson, on lands adjoining Piper's, and about the same distance from Canton. This coal varies in thickness from four to five and a half feet, and at all the localities examined in this county, the seam is invariably divided a little below the middle, by a clay parting from one to two inches in thickness. This character alone, will serve to distinguish this seam any where in this county, from either of those below it. This coal is usually overlaid by a hard, black shale, from six inches to two feet in thickness, which comes immediately above the coal, and is succeeded by buff, or yellow shaly, or compact limestone, above which comes a heavy bed of sandstone. At some localities, the slate and limestone are wanting, and the sandstone rests directly upon the coal. Where the limestone is present, it contains a great number of minute fossils, resembling grains of wheat, and about the same size. This small fossil is called *Fusulina*, of which there are two or three species in the Coal Measures of this State, and they may be regarded as the characteristic fossils of this coal. It is also frequently underlaid by a calcareous fire clay, containing a fossil coral in great abundance, known as *Chætetes milleporaceous*, which, so far as we know, has not been found in this State below the horizon of this coal, but has also been found in connection with No. 7. There is also a thin layer of limestone above No. 6 coal, that appears to be mainly composed of the remains of minute *Foraminifera*, and polished sections of the stone exhibit many of these microscopic fossils in an excellent state of preservation.

Six miles northeast of Canton, on a branch of Copperas creek, near Mr. Rosenbaum's place, this coal has been worked by tunneling into the base of the hill, on the outcrop of the seam, and the strata intervening between this and the upper seam are well exposed. The distance between these coals at this point is 37 feet, and the intervening strata consist entirely of sandy and argillaceous shales. These two coals are also found together at Powel's coal bank about two miles east of Norris, where No. 6 has been mined for several years to supply the coal demand of the surrounding region.

Burbridge & Co.'s shaft, one mile west of Farmington, in the valley of one of the branches of Coal creek, reaches coal No. 6 at a depth of twenty-six feet. The coal is four feet and a-half in thickness at this shaft, and similar in quality to that at Piper's mine, near Canton. This seam lies about ninety feet below the level of the town of Farmington, and coal No. 7 outcrops on the hill side east of Burbridge's shaft, and from thirty-five to forty feet above No. 6. Two miles northeast of Fairview, No. 6 is mined in the bluffs of Coal creek, and is here about four feet and a-half in thickness, with a good roof of black slate, above which there is about twenty feet of massive sandstone. This seam probably underlies some three or four townships, north and east of Canton, and may be reached any where in that region at a depth varying from twenty-five to one hundred feet.

Coal No. 7 is the highest coal strata seen in this county, and being usually only from sixteen to twenty inches in thickness, no attempt has been made to mine it in competition with the thicker seams that underlie it, and outcrop over a much wider area in this county. Judging only from the appearance of the coal, where it was exposed in natural outcrops, we were disposed to regard it as a coal of a very superior quality, good enough, apparently, to be used in the iron furnace without coking, and hence, if it should be found as much as two feet in thickness, at some favorable locality, it might be mined as successfully as some of the heavier seams are at the present time. It outcrops on the head of Big creek, about a mile north of Piper's mine, along most of the hillsides east of Norris, to Copperas creek, and also underlies all the highlands about Farmington. At Powel's mine, two miles east of Norris, the following measured section was made, showing the relative position of the two upper coals, and the character of the strata associated with them, and they constitute the highest beds of the Coal Measures seen in this county:

	FEET.	IN.
Compact, hard gray limestone	4 to 6	
Shale, partially hidden	15	
Coal No. 7	1	4
Shale, and shaly sandstone	35	
Brown argillaceous limestone	2	6
Bituminous shale	1 " 2	
Coal No. 6	4	6

The limestone at the top of this section appears to form the bed rock over the highest ground in the region of Farmington, where it is immediately overlaid by the Drift deposits, and is probably the highest rock exposed south and west of the Kickapoo. Just over the line, in Peoria county, the bed is twenty feet or more in thickness, which was probably its original thickness in the vicinity of Farmington, but it has been reduced to its present thickness, perhaps by erosion anterior to, or during the Drift period.

Conglomerate.—At the base of the Coal Measures, in this county, there is from ten to twenty-five feet of coarse grained sandstone, which probably represents the conglomerate usually underlying the lower coals. This sandstone was only seen at two or three points in the bluffs of Spoon river, between Seaville and Bernadotte. Just below Seaville Station, it measures about twenty-five feet in thickness, extending from the under clay of No. 1, which rests immediately upon it, down to the low water level of the river, where it rests upon the St. Louis limestone. The sandstone is here a massive, coarse grained rock, quite ferruginous, and forms a mural cliff, from its tendency to harden on exposure. At Bernadotte, it is thin bedded, and partly shaly, and crumbles readily on exposure to the atmosphere. It is quite irregular in its development and general aspect, and cannot always be identified unless found in connection with the coal seams above, or the limestones below, because of its close resemblance to some other sandstones of the Coal Measures.

St. Louis Limestone.—The outcrop of this formation appears to be restricted to the valley of Spoon river, between Bernadotte and Seaville, and there are but few points where it is well exposed. At Bernadotte, there is only from six to ten feet of this limestone exposed above the lower water level of the river. The rock is concretionary in structure, and contains *Lithostrotion proliferum* and *L. canadense*, the most characteristic fossils of the upper division of this formation. Just above the mouth of Barker's run, on Spoon river, the following section of this limestone group was seen:

	FEET.
Gray concretionary limestone	10
Bro. magnesian limestone	12
Arenaceous beds, partly hidden	16

The two lower divisions of the above section are tolerably even bedded, the layers varying in thickness from six inches to two feet, and will afford an excellent building stone. The magnesian limestone is especially valuable for culverts and bridge abutments, where a rock is required to resist the combined influence of frost and moisture. A very fine specimen of *Lithostrotion canadense* was found at this locality by Mr. James H. Cooper, and presented by him to the State Cabinet. We saw no other locality in the county where so great a thickness of this formation was exposed as at this point.

Economical Geology.

Bituminous Coal.—The great mineral wealth of this county, as must be apparent from the perusal of the preceding pages, consists in its almost inexhaustible beds of coal, which are so distributed as to be easily accessible to every portion of the county. The three lower seams, ranging from two to four feet in thickness, outcrop on all the principal streams in the southern and western portions of the county, while coals 4, 5 and 6, the thickest and most valuable seams known in the northern portion of the State, underlie the central and northeastern portions of the county, and are easily accessible at any point where a large supply of coal may be required. These coals underlie nearly, or quite, seven townships in this county, with an aggregate thickness of about fourteen feet, and throwing out of the calculation entirely, No. 5, which is more local in its development than the other two, we still have an aggregate of from nine to ten feet of coal, equal to 9,000,000 tons of coal to the square mile, as the product of these two seams, from the central and northeastern portions of the county alone, and within one hundred and fifty feet of the surface, at the general level of the prairie region. Coal mining is yet in its infancy in this most highly favored region, and until the construction of the two railroads which now intersect the county, the demand for coal was too limited to justify any large expenditures in coal mining operations. Now, an extensive market is opened on the Mississippi river for the coals of this region, and the cities of Burlington and Keokuk, in Iowa, and Warsaw, in this State, will soon obtain their main supplies of coal from this county.

In quality, the coals to be obtained here, are fully equal to the average of our Illinois coals, and they will answer all the purposes for which coal is required, except for the smelting of iron in the raw state, and it is probable that a part of No. 6, and the whole of No. 7, if it could be found thick enough to be worked successfully, could be used in the iron furnace without coking. No. 6 is generally a soft coal, with a tendency to break into cubic blocks, and has afforded the following result, on analysis, by Messrs. Blaney & Mariner, of Chicago:

Water	6.17
Ash	1.91
Bitumen	29.82
Carbon	62.10
	100.00
Coke	64.01

The specimens affording the above, which is the average of two analyses, was taken from Mr. Piper's mine, two miles north of Canton. An analysis of specimens from John Winterbottom's mine, two miles southeast of Cuba, probably No. 4 coal, gave the following as the average result of two analyses:

Water	5.18
Ash	7.51
Bitumen	30.06
Carbon	57.25
	100.00
Coke	64.76

An analysis of No. 6, from Effnour's mine, near Cuba, gave, as the average of two analyses, the following:

Water	5.94
Ash	5.38
Bitumen	30.80
Carbon	57.85
	99.97
Coke	63.23

These analyses of the two most important coals in the county, will serve to indicate the average quality of the coals of this region, and also show the variations that may occur in the quality of the coal from the same seam, at different localities, as evidenced by the result of the analyses of specimens of No. 6 from Effnour's mine, near Cuba, and from Piper's mine, near Canton. At the former locality, the coal contains a much larger per cent. of ash, with more bitumen and less carbon than at the latter, and in quality it seems to be considerably below the average of the coal from this seam at other localities in the county.

The following analysis of coal No. 2, from Colchester, in McDonough county, is given here to indicate its general character in this portion of the State. It is taken from Norwood's "Abstract of a Report on Illinois Coals," and was made by the late Mr. Henry Pratten, former assistant in the Illinois Geological survey:

Specific gravity	1.290		
Loss in coking		41.2	
Total weight of coke		58.8	100.00
Analysis: Moisture		5.4	
Volatile matters		35.8	
Carbon in coke		56.8	
Ashes, (white)		2.0	100.00
Carbon in coal	60.10		

Coal No. 5, as has already been stated on a preceding page, is rather local in its development, and was only seen in the vicinity of Cuba, and at John Williams's mine, five miles and a half northeast of Canton. The coal afforded by this seam is more like that from No. 6, being softer and lighter than the coal of No. 4.

The lower seams are generally much thinner than those above, and usually range from two to four feet in thickness, but afford a very good coal, especially No. 2, which, in its average quality, is probably not surpassed by any coal in the State. Nevertheless, occurring here in close proximity with seams much thicker, and more favorably situated for working extensively, it will only be mined along the outcrop of the seam, for the supply of the immediate neighborhood, until the thicker beds overlying it are partially exhausted. It is but seldom that No. 1 is found thick enough to be mined profitably, and the mines at Seaville are the only ones that we met with in this seam, in the county. No. 3 has been opened at several points, but the mines have been subsequently abandoned, probably because it could not be successfully worked in competition with No. 4, which usually outcrops in the same vicinity.

Cannel Coal.—A thin seam of cannel coal occurs in the vicinity of Avon, in the northwest corner of the county, and before the discovery of the vast deposits of oil in Pennsylvania, was mined for the distillation of oil. We first visited the locality in 1859, and found ten retorts in operation at that time, the product of which was said to be from three to five hundred gallons of oil per day. The seam from which the material was supplied, was only from fourteen to twenty inches in thickness, and the cost of mining at that time was about two dollars per ton. It was said to yield about thirty gallons of oil per ton, but the subsequent discovery of oil in Pennsylvania and Ohio, put a stop to its manufacture from cannel coal in this region.

Fire Clay.—A good bed of fire clay, from three to five feet in thickness, occurs below the cannel coal at Avon, and was worked by the Avon Coal Company, in connection with the coal, and they were thus enabled to manufacture the fire brick required for their own furnaces. At Andrews's coal bank, two miles and a half north of Marietta, there is from two to three feet of good fire clay below the coal, and at many other localities in the county, especially in connection with the lower coals, clays suitable for pottery or fire brick may be obtained.

Iron Ore.—Iron ore, in considerable quantities, was met with at several localities in the county. In the vicinity of Seaville there is a bed of *limonite*, from eight to twelve inches thick immediately above the limestone that forms the roof of the lower coal. This ore closely resembles that at Chadsey's place, in Schuyler county, an analysis of which is given in the report on that county, in the preceding chapter, and it holds about the same stratigraphical position. The same band of ore was seen in the vicinity of Avon, and it probably extends over a large area in the county. In the vicinity of Utica, there is a considerable amount of impure carbonate of iron, occurring in regular layers of nodules, or kidney shaped concretions, disseminated in bands through a bed of clay shale, from fifteen to twenty feet in thickness. The bands of ore are from two to three inches thick, and are separated by from two inches to a foot in thickness of shale, and the aggregate thickness of this ore at this locality, would be from three to four feet, and it would probably yield from thirty-five to forty per cent. of iron. The shale in which this ore is embedded, is probably the shale over coal No. 3, and if so, an abundant supply of coal could be obtained on the spot, either from that seam, or No. 2, which lies from forty to fifty feet below it. The roof shales of coals Nos. 4 and 5, abound in large ferruginous concretions, but they are generally too strongly charged with pyrites to be of any value for the iron furnace. Iron ore is almost universally disseminated through the Coal Measures in this State, but usually in too small quantities to be of any great value for the production of metallic iron, but it is quite probable that the ores of this county may at some future time, become valuable for this purpose.

Building Stone.—The Coal Measures seldom afford large bodies of limestone of sufficient thickness, and of the right quality for good building stone, and this material has to be mainly supplied from the sandstones, which are usually the prevailing rock in the coal regions. There are some beds of limestone, however, in this county, that furnish a suitable material for rough walls, though the supply is quite limited. The limestone that immediately overlies coal No. 6, in the vicinity of Cuba and Canton, as well as at several other points in the county, affords some good building stone, and the Farmington limestone, which overlies coal No. 7, also affords some tolerably good rock, in rather thin layers, that has been used very generally in the vicinity of its outcrop, and answers very well for foundation walls, etc. The gray concretionary limestone of the St. Louis group, which is found in the bed of Spoon river below Seaville, and at Bernadotte, is not regularly stratified, and therefore not a good building stone, but on Barker's run, near where it empties into Spoon river, there is about twelve feet of brown magnesian limestone in regular beds, underneath the gray beds of this group, that will afford the most durable stone to be found in the county.

Sandstones are abundant, and easily accessible to most parts of the county, and when carefully selected they answer a good purpose for foundation walls, and for various other purposes. In the vicinity of Seaville, the sandstone both above and below coal No. 1, is found in heavy beds, and seems to be sufficiently coherent to form a durable building material. The stone for the bridge abutments and culverts, on the T. P. and W. railroad in this vicinity, has been taken from these beds, and although sufficient time has not yet elapsed to fully test its durability, it seems to be a reliable stone for building purposes. In the vicinity of Lewiston, there is a bed of sandstone intervening between coals 2 and 3 which is a good freestone, and has been extensively quarried and used as a building stone in the city and vicinity. It is not altogether uniform in its texture, however, and requires to be very carefully selected where it is to be used in the construction of permanent buildings. In the vicinity of Canton, a very good bed of sandstone is found below coal No. 6, and further north there is also a heavy bed of the same kind of rock overlying this coal, which was seen at the mines on Coal creek, two miles and a-half to three miles northeast of Fairview, and at some other points. Most of these sandstones are more or less ferruginous, the iron, in the form of a brown oxyd, being disseminated in minute grains through the entire substance of the rock, giving it a tendency to harden on exposure to atmospheric influences, thereby improving its quality and durability as a building material.

Limestone for Lime.—The gray concretionary beds of the St. Louis group, which outcrop in the valley of Spoon river, from Seaville to Bernadotte, will afford the best material for the manufacture of quick lime to be found in the county. This rock is usually a nearly pure carbonate of lime, and the beds in the vicinity of Alton, which also belong to this group, afford the purest and whitest lime made in the State. The gray beds, which are the only ones adapted to this purpose, are only from eight to ten feet in thickness in this county, and form the upper portion of the group, on which the conglomerate sandstone of the Coal Measures rest.

The limestone over No. 6 coal may also be used for the manufacture of quick lime, but at some localities it is too argillaceous, and when burned does not slack readily, and might make a good hydraulic cement, to which it seems best adapted. The limestone above No. 7 coal, is generally a purer carbonate of lime than any other of the Coal Measure limestones in this county, and might be extensively used in the vicinity of Farmington for lime burning.

Sand and Clay for Brick.—These materials are abundant on all the uplands in the county. On the bluff lands, adjacent to the Illinois river, the Loess affords an excellent material for this purpose, in which the ingredients are often mixed in just the right proportions. The sub-soil of the prairies, and of the oak ridges, furnish an abundance of brown clay, which, mingled with sand, that is abundant in the beds of the streams, forms a good material for this purpose. These materials are so universally distributed, that they may be readily found in every neighborhood, and on almost every farm in the county.

Soil and Agriculture.—There is considerable variety in the soils of this county, though there are none so poor that they will not produce good crops annually of most of the cereals usually grown in this region, when judiciously cultivated. The most productive soils are those covering the prairie lands, and those underlaid by the Loess, in the vicinity of the river bluffs. The latter were originally covered with a heavy growth of timber, consisting of sugar-maple, black and white walnut, linden, elm, hackberry, wild-cherry, honey-locust, black and white oak, and two or three varieties of hickory. This is the character of the best lands in the vicinity of Lewiston, and over a considerable area along the eastern borders of the county. They produce quite as heavy crops of corn, wheat, oats, barley and grass, as the best prairie soil, and are much better adapted to the growth of fruit, especially grapes and apples. The peach seems to grow equally well on the prairie, though it is doubtful whether the trees would live as long, or produce as freely, as on the timbered lands. The prairie lands are very productive, and have a deep chocolate brown or black loamy soil, rich in organic matters, and when sufficiently rolling, produce annually large crops of corn and grass. Wheat is a far more uncertain crop on the prairie soil than on lands originally covered with timber. The poorest lands in the county are the white oak ridges, that skirt the borders of the small streams. These lands have a thin soil, with a stiff clay sub-soil, but will produce fair crops of wheat, oats and clover, and are also equal, if not superior, to the prairie lands for the growth of fruit. They require a more generous treatment, and are greatly benefited by occasional fallowing, and plowing under green crops.

For the following complete list of the forest trees and shrubs indigenous to this county, I am indebted to Mr. John Wolf, of Canton, whose quiet and unobtrusive labors in botany, geology, and conchology, have resulted in important additions to our knowledge in these departments of Natural History. The State collection is also indebted to him for a fine series of the fossils of the Coal Measures in this vicinity, and I am also under personal obligations to him for much valuable information in regard to the most important localities to be visited in this county. To Mr. David Williams and family, of Canton, I am personally indebted for the generous hospitality extended to me while engaged in the survey of this county, and for valuable information and assistance in the prosecution of the field work of the survey. I am also under obligations to Mr. Harris, near Seaville, for hospitable entertainment, while at work in that vicinity, and to the citizens generally for acts of personal kindness, and assurances of interest in the general results of the work in which I was engaged:

LIST OF THE TREES AND SHRUBS FOUND IN FULTON COUNTY.

Acer dasycarpum, *Ehr.* Sugar maple.
A. sacharinum, *Wang.* White, or silver maple.
Æsculus glabra Willd. Buckeye.
Amelanchier Canadensis, *T. & G.* Service berry.
Amorpha fruticosa L. False indigo.
Ampelopsis quinquifolia, *Mich.* Virginia creeper.
Betula nigra L. Red birch.
Carpinus Americanus, *Mich.* American hornbeam.
Carya alba, *Nutt.* Shell-bark hickory.
C. amara, *Nutt.* Swamp hickory.
C. olivæformis, *Nutt.* Pecan nut.
C. tomentosa, *Nutt.* Mocker nut.
C. sulcata, *Nutt.* Thick shell-bark.
Ceanothus Americanus, *L.* New Jersey tea.
Celastrus scandens, *L.* Bitter sweet.
Celtis occidentalis, *L.* Hackberry.
Cophalanthus occidentalis, *L.* Button bush.
Cercis Canadensis, *L.* Red bud.
Cornus alternifolia, *L.* Alternate leaved cornel.
C. paniculata, *L'Her.* Panicled cornel.
C. sericea, *L.* Silky cornel.
C. asperifolia, *Mich.* Rough leaved dogwood.
Corylus Americanus, *Walt.* Hazel nut.
Cratægus coccinea, *L.* Red thorn.
C. crus-gallii, *L.* Cock spur thorn.
C. tomentosa, *L.* Black thorn.
  var. *a. C. mollis*, *T. & Gray.*
  " *b. C. flabellata*, *Bosc.*
  " *c. C. pyrifolia*, *Ait.*
  " *d. C. punctata*, *Jacq.*

Diospyros Virginianus, *L.* Persimmon.
Euonymus Americanus, *Jacq.* Waahoo.
Fraxinus Americanus, *L.* White ash.
F. viridis, *Mich.* Green ash.
F. pubescens, *Lam.* Red ash.
F. quadrangulatus, *Mich.* Blue ash.
F. sambucifolius, *Lam.* Black ash.
Gleditschia triacanthus, *L.* Honey locust.
Gymnocladus Canadensis, *Lam.* Coffee nut.
Hydrangea arborescens, *L.* Wild hydrangea.
Juglans nigra, *L.* Black walnut.
J. cinerea, *L.* White walnut, or butternut.
Juniperus Virginiana, *L.* Red cedar.
Lonicera parvifolia, *Lam.* Small honeysuckle.
Morus rubra, *L.* Red mulberry.
Negundo aceroides, *Mœnch.* Box elder.
Ostrya Virginica, *Willd.* American hornbeam.
Platanus occidentalis, *L.* Sycamore.
Populus tremuloides, *Mich.* American aspen.
P. granditentata, *Mich.* Large toothed aspen.
P. monilifera, *Ait.* Cottonwood.
Prunus Americanus, *Marsh.* Wild plum.
P. Virginiana, *L.* Choke cherry.
P. serotina, *Ehr.* Wild black cherry.
Ptelea trifoliata, *L.* Hop tree.
Pyrus coronaria, *L.* Crab apple.
Quercus alba, *L.* White oak.
Q. Leana, *Nutt.* Lea's oak.
Q. coccinea, *Wang.* Scarlet oak.
Q. castaria, *Willd.* Chestnut oak.
Q. imbricaria, *Mich.* Laurel oak.
Q. rubra, *L.* Red oak.
Q. palustris, *DuRoi.* Pin oak.

LIST OF THE TREES AND SHRUBS FOUND IN FULTON COUNTY—Continued.

Q. bicolor, *Willd.* Swamp white oak.

Q. macrocarpa, *Mich.* and var. *olivæformis*, *Mich.* Bur oak.

Rhamnus lanceolatus, *Pursh.* Buck thorn.

Rhus glabra, *L.* Smooth sumac.

R. aromatica, *Ait.* Fragrant sumac.

R. radicans, *L.* Poison ivy.

Ribes floridium, *L.* Wild black currant.

R. rotundifolium, *Mich.* Wild gooseberry.

Rosa setigera, *Mich.* Prairie rose.

R. lucida, *Ehr.* Dwarf wild rose.

Rubus villosus, *Ait.* Blackberry.

R. occidentalis, *L.* Black raspberry.

Sambucus Canadensis, *L.* Common elder.

Sassafras officinalis, *Nees.* Sassafras.

Similax rotundifolia, *L.* Green briar.

Staphylea trifolia, *L.* American bladder nut.

Tillia Americana, *L.* Basswood or linden.

Salix tristis, *Ait.* Dwarf gray willow.

S. humilis, *Marshall.* Bush willow.

S. nigra, *Marshall.* Black willow.

S. longifolia, *Muhl.* Long leaved willow.

S. cordata, *Muhl.* Heart leaved willow.

S. angustata, *Pursh.* Narrow leaved willow.

S. eriocephala, *Mich.* Silky headed willow.

Ulmus Americanus, *L.* American elm.

U. fulva, *Mich.* Slippery or red elm.

Viburnum Lentago, *L.* Sheep berry.

Zanthoxylum Americanum, *Mill.* Northern prickly ash.

CHAPTER VII.

DEKALB, KANE AND DUPAGE COUNTIES.

These three counties, the description of which is included in the present chapter, are situated contiguously to each other, in the northeastern portion of the State, and together comprise a rather irregularly shaped area of about fifteen hundred square miles. Their respective boundaries and areas are as follows:

DeKalb county is bounded on the north by Boone and McHenry counties, on the east by Kane and Kendall counties, on the south by LaSalle county, and on the west by Lee and Ogle counties. It comprises an area of eighteen townships, or about six hundred and forty square miles. The remaining boundaries of Kane county are, McHenry county on the north, Cook and DuPage counties on the east, and Kendall county on the south. Of DuPage, Cook county on the north and east, and Will county on the south. The areas of these two counties are, respectively, about five hundred and twenty-eight and three hundred and thirty square miles.

The principal water courses in this territory are, first: the Fox river, which traverses the whole length of Kane county, near its eastern border; the Kishwaukee or Sycamore river, which, rising in the western part of Kane, runs through the northern portion of DeKalb county, and the DuPage, which, with its two forks, drains nearly the whole of DuPage county. These, with their tributaries, and a few minor streams, furnish an abundant supply of water in all parts of this district. Springs are not generally numerous, excepting in the immediate vicinity of the water courses.

The predominating character of the surface of the country, in this district, is that of an upland rolling prairie, with, however, numerous groves, or timber islands, and extensive wooded tracts along the principal streams. The proportion of wooded land to prairie may perhaps be as small as one to three or four, but the checking of the prairie fires which formerly swept over this region, and the greater attention which has of late years been given to arboriculture, have probably made up for the deficit caused by the cutting down of the timber for fuel and other purposes, and it may perhaps be safely said that the amount of surface actually occupied by growing woods, excepting in a few localities in the immediate vicinity of the railroads, is not less at the present time than in the period of the early settlement of this region. The principal kinds of timber are, black, white, red and bur oaks, bitternut and shell-bark hickory, black-walnut, butternut, elm, black and white ash, soft maple, sugar maple, and cottonwood. The red cedar and arbor-vitæ are also found in a few localities in this district. The varieties of soil are altogether the same as have been described in the reports on the adjoining counties—on the prairie a deep, black or dark brown humus, and in the timber a lighter colored, sandy clay soil or loam. In a few localities the sandy or gravelly character of the soil is more predominant, as in township 42, ranges 6 and 7, in the northern part of Kane county, where some of the ridges or irregular elevations of land, separating small wet prairies or sloughs, are quite sandy. These low prairies are found, of inconsiderable area, in various portions of the district, but are more abundant in this particular region. Along some of the principal streams, and especially the Fox river, in Kane county, the country is more roughly broken, and can in some parts even be called hilly, although the more abrupt elevations seldom exceed eighty or one hundred feet above their immediate base.

The geological formations, othert han the surface deposits of Alluvium, Drift, etc., which appear at the surface in this district, comprise portions of the Niagara, Cincinnati, and Trenton groups. The St. Peters sandstone, also, judging from facts developed in the survey of LaSalle county, probably underlies a portion of the southern part of DeKalb county, but as the whole of that region is covered with heavy accumulations of Drift, no exposures of this formation are to be found. The exposures of the older rocks are found only along the courses of the larger streams, and at one or two isolated localities in DuPage county, on the easternmost borders of the district. Elsewhere they are overlaid with heavy deposits of Drift, varying from twenty to eighty or one hundred feet in thickness, and in some localities even more.

Above the Drift proper, we have only the surface soils and a few local alluvial deposits in the river bottoms, etc. Some of the springs along the upper course of the Fox river, in Kane county, issuing from the lower limestone bed of the Niagara group, hold much lime in solution, and deposit calcareous tufa. A considerable deposit of this material occurs on the eastern bank of the river, about three miles north of the city of Elgin, and close to the track of the Fox River Valley railroad. This deposit was formerly quarried for the manufacture of lime, and is exposed in the excavations to the depth of about four feet. It appears to be regularly bedded, and varies in structure from a loosely compacted, porous material, resembling petrified moss, and full of traces of vegetable remains, to a compact travertin, almost resembling in density some of the older rocks. The whole extent of this deposit is not to be seen, as it is covered by from one to four feet of soil bearing large forest trees. It is exposed, however, for a distance of several rods in the ditches alongside of the railroad track.

The remains of extinct Post Tertiary mammals have been found in the superficial deposits in one or two localities in this district. A portion of the remains of a Mastodon, consisting of the tusks and several teeth, were obtained in excavating for the track of the Chicago, Burlington and Quincy railroad near the City of Aurora, and are now preserved in the museum of Clark Seminary, at that place. The skull, and it is said the other parts of the skeleton, also, of Castoroides Ohioensis, were found by a farmer in a slough not far from the town of Naperville, DuPage county. The skull was obtained by Col. Wood's museum, in Chicago, where I believe it still remains.

The deposits of the Drift, in this district, consist of loam and blue clays, and hard-pan, with here and there, amid the mass, seams and pockets of sand and gravel. Boulders of granite, quartzite, greenstone, and various other rocks, are abundant in varions localities on the surface of the ground, and are frequently met with in excavations for wells, etc., and large deposits of rolled boulders, chiefly of limestone from the underlying Niagara beds, similar to those already described in the report on Cook county, occur in the Drift deposits of the adjoining portions of Kane and DuPage counties. These may be well observed in the vicinity of Elgin, and, in DuPage county, near Danby and Bloomingdale. Sections of the bluffs in various places along Fox river, show that the materials of the Drift have been rearranged, and present a stratified appearance. The limestone boulder deposits may, perhaps, be referred to this modified Drift.

Pieces of wood, and occasionally large trunks and branches of trees, have been found at considerable intervals in the Drift, and such cases are reported in various parts of this district. At Sycamore, in DeKalb county, large pieces of wood were said to have been met with, in the blue clays of this formation, at the depth of fifty feet, in digging a well, and other instances were mentioned, though no particulars were given.

It is not easy to estimate the thickness of these deposits in all parts of this district, as it is very seldom penetrated by wells or any artificial excavations; nor is there generally in any such works any record kept of the materials, which would also be very desirable in the study of this formation. The bluffs along Fox river, however, furnish partial data for a portion of the district, and, judging by these, the Drift will average from fifty to one hundred feet in thickness, above the uppermost bed of rock. Away from the river, on either side, the thickness is most probably not less, and may be even more. At Sycamore, a well is said to have reached, by digging and boring, a depth of (?) feet, without penetrating the blue clays and hard-pan of this formation.

The artesian well bored by the Chicago, Burlington and Quincy railroad company, at their work-shops, in the City of Aurora, affords a means of ascertaining the thickness of the older geological formations at that point. In this boring, after passing through thirty, or more, feet of the alluvial surface deposits of the river valley, the section afforded is as follows:

	FEET.
1. Alternating beds of grayish white and gray limestone, sixty-eight feet, followed by forty feet of buff or brown limestone, *Niagara group*	108
2. Sixty-four feet of light grayish limestone, underlaid by one hundred and one feet of shale and shaly beds, the middle portion dark colored and bituminous, *Cincinnati group*	165
3. Gray, buff, and nearly white limestone, *Galena and Trenton*	282
4. Buff and reddish yellow sandstones, *St. Peters*	158

A comparison between the record of this boring and the Chicago section, given in the report on Cook county, will show a very considerable diminution in the thickness of the different formations above the St. Peters sandstone. In the Chicago section, the total vertical thickness of all the strata between the base of the Niagara and the top of the St. Peters sandstone, is six hundred and thirty feet, which is here decreased to three hundred and ninety-seven feet, a very noticeable difference. As, however, none of the beds below the upper portion of the Galena limestone are represented in the surface exposures within the limits of this district, the remainder of this section only is of general interest.

Niagara Group.—This formation underlies the whole eastern portion of the district, including the whole of DuPage county, and the greater part, if not all of Kane county. Its western border cannot be located with any certainty. It seems quite probable, indeed, that it extends westward through the central portion of DeKalb county, but, from the want of outcrops, this point cannot be determined.

The lower part of this group, which alone is exposed in this district, consists of gray, buff and sometimes nearly white, limestones, in some cases dolomitic in composition, and in others nearly pure, and affording a good material for the manufacture of quick lime. The beds also contain much chert, unequally distributed throughout the strata, in thin seams and lenticular masses. A large portion of the rock, however, is quite free from this material, and answers excellently well as building stone. Its aggregate thickness in this district cannot be easily ascertained. In Kane county, the section before given probably includes all the beds exposed, but to the eastward the outcrops are not so easily identified with it. At the utmost, however, it will probably not exceed one hundred and fifty feet, if, indeed, it approaches that thickness. The principal outcrops are as follows:

In the eastern portion of DuPage county, on the northwestern quarter of section 2, township 39, range 11, about half a mile west of the railway station at Cottage Hill, a light gray or nearly white sub-crystalline limestone is quarried. The rock is concretionary in its structure, showing bedding very imperfectly, and though very full of traces of organisms, affords but very few well preserved fossils. The whole depth of the quarry is fifteen or twenty feet, but at the time of my visit only about ten feet of the upper portion was exposed, the bottom of the quarry being filled with water. Directly east of this point, in the village of Cottage Hill, rock is said to have been struck in a well at a depth of twelve feet. The rock exposed in this quarry is not seen in any of the other outcrops in this district so as to be identified by its lithological characters. It seems possible, indeed, that this may be the uppermost bed of the Niagara group within these limits.

Passing to the southward about three miles, we find the nearest outcrop occurring on the western bank of Salt creek, in the southwestern quarter of section 14, on the land of Mr. Torode. About nine feet in thickness of thin bedded limestone is here exposed, the upper two or three feet, porous and yellow, the remainder, a rather even textured stone, light drab or gray in color, and containing numerous nodules of chert. The beds appear to increase in thickness, the deeper the rock is worked. There is in this quarry a slight, in some places almost imperceptible, local dip to the northward. The upper portion of the rock exposed at this place, is fossiliferous, affording various corals, crinoids, bryozoa, and brachiopoda, but generally ill preserved, and often indistinguishable as to species.

Further to the southward, no exposures are met with, until the vicinity of the DesPlaines river is reached, where we find the bottom land opposite Lemont, underlaid by limestone beds. The rock also appears to a limited extent, near the base of the bluffs, on the northwestern edge of the river bottom, but no good exposures are met with on this side of the river. On the flats, it is generally covered with a thin layer of surface soil, and wherever it does appear at the surface, is so changed by weathering as to make an almost complete alteration in its appearance. It seems probable, however, the beds at a sufficient depth under the surface, may afford a good building material.

To the northwestward of this, the only remaining outcrops of rock in DuPage county, are met with on the western fork of the DuPage river, at Naperville and below. At Naperville, in the quarries on the southwestern bank of the creek, just below the milldam, there is a section, consisting at the base, of an even textured, regularly bedded, light drab or buff limestone, about six feet of which is exposed in the excavation. Nodules of chert, of irregular flattened forms, are quite frequent in the upper part of this bed, but less abundant below, where the layers also appear to be thicker and more adapted for a building stone. This bed is overlaid by about nine feet, in vertical thickness, of a thin bedded, yellowish, or dark buff limestone, showing a light gray color, on freshly fractured surfaces, and closely resembling the upper portion of the rock at Torode's quarry, on Salt creek. The upper beds in these quarries afforded specimens of *Atrypa reticularis*, *Strophomena rhomboidalis*, *Orthis flabellum*, *Leptæna transversalis*, *Spirifera radiata*, *S. Niagarensis*, *Orthoceras undulatum*, *Calymene Blumenbachii*, and species of Illænus and Sphærexochus, together with many corals and bryozoa. The lower beds were altogether less abundant in individuals; the species were mainly the same. In many cases, the fossils were merely casts, but some were nearly perfect.

Going from Naperville, in a southeasterly direction along the western bank of the creek, we find, at a distance from the town of a mile or a mile and a half, limestone, apparently the same as the upper beds at Naperville, occurring in the bottom of ditches and small runs, and alongside of the road. Still farther on, at Kimball's mill, a thickness of eight or nine feet, probably of the lower bed, is shown at the western end of the milldam, on the right bank of the stream. On the opposite bank, about two hundred yards above the dam, on the southeastern quarter of section 19, township 38, range 8, the upper beds are well exposed, and have been quarried. Here, they yield in abundance, the same species of fossils as at Naperville, and in the same condition. Below Kimball's mill, the lower beds of buff limestone appear along the western bank of the creek for a short distance, and have been quarried at one or two points. It disappears entirely, however, under the Drift, before reaching the county line.

In Kane county, all of the exposures of rock, with one exception only, are along Fox river. Along this line of outcrop, the greatest development of the formation is at Aurora and Batavia, and between these two points. Both above and below this particular portion of the river, a lesser thickness of the formation is exposed, Commencing at the southern limit of the county, and going up the river, the following are the principal exposures met with:

At the village of Montgomery, and almost exactly on the southern line of the county, there is an exposure of about eight or nine feet of thin bedded buff limestone, abounding in thin seams and flattened nodules of chert, which appears much broken up and decomposed on the exposed surfaces. No good specimens of fossils were obtained at this point, and only a few unrecognizable fragments were observed. On the opposite side of the river, at the eastern extremity of the milldam, rock was again observed, similar in lithological character to that at the first mentioned outcrop, only that it was harder, less decomposed, and more free from chert. A slight dip, one or two degrees, to the northeast or a little more north, was observed at these exposures, which would apparently bring the one last described above the other. The whole thickness, however, including both exposures, and such intermediate beds as may be concealed by surface deposits, cannot well exceed twenty-five or thirty feet.

Continuing up stream, no outcrops or exposures of rock in place, are met with, until entering the city of Aurora. Here, in the southern part of the city, on the eastern bank of the river, at Hoyt's quarry, about forty feet of the limestone is exposed. Of this, the upper nineteen or twenty feet is a rather thin bedded buff limestone, with chert very abundant in layers and lenticular nodules. The remainder of the excavation, below this, is in a regularly bedded impure limestone, varying in color from light gray to buff or drab, and closely resembling in appearance portions of the well known Joliet stone. The dip in this quarry is to the northeast, and amounts to from one to four degrees. The line of separation between the upper and lower beds is quite distinct in this section. In the upper beds, a few indistinct fossils were observed: *Atrypa reticularis*, and *Orthoceras undulatum*, were the only species recognized. The lower portion of the quarry, on the other hand, appeared to be entirely destitute of fossils, but abounded in small geodes, containing crystallized quartz.

In the northern part of the city, the limestone again appears on the western bank of the river, at first, only at the edge of the water, but gradually appearing higher on the bank, further up the stream. It also underlies the surface farther up the bluffs, but how high cannot be exactly ascertained, as it is mostly covered with soil. Nearly a mile above the city, there are several quarries on the side of the bluffs, on the western bank of the river, which show vertical cliffs of limestone from fifteen to twenty-five or thirty feet, or higher. The stone in these quarries is an impure limestone, in some layers approaching a true dolomite in composition, of a decidedly buff or yellow color. Some of the beds, in some localities, are deeply stained with oxyd of iron, and present a dark, reddish brown color. There was here, apparently, a slight local dip to the westward, which, however, was not very noticeable. There may be, possibly, a slight undulation of the strata, or anticlinal, having a strike about northwest and southeast, but at all events, it is very inconsiderable, and does not affect the general disposition of the strata in this region. I have considered the rock exposed in these quarries, and along the river bank, as below the cherty beds of Hoyt's quarry, and, perhaps the equivalent of the strata immediately below them, though not exactly agreeing in lithological characters. I have, however, no positive proof of this. But few fossils are to be found at these localities; the only specimens obtained were two or three imperfect *Calymene Blumenbachii*, and the pygidium of an Illæns.

To the north of these quarries, along the western bank of the river, and, though to a somewhat less extent, on the eastern bank also, ledges of rock are seen almost continuously, near the water's edge, for some seven miles, as far as the town of Batavia. In most cases only a very limited thickness of the weathered edges of the strata are to be seen; at none of the intermediate points is there to be seen a good section, where either of the beds observed in the southern exposure at Aurora, can be recognized. The strata generally lie nearly level, though there are, in some places, appearances of local dipping, which may perhaps be sometimes due to the undermining and consequent tumbling of large masses of the rock. About two miles and a-half north of Aurora, a cherty band may be traced in the rock for a short distance, and then disappears. It, or another similar one, again appears at the base of the bluff near the mouth of Mill creek, about a mile and a-half below Batavia. For nearly half a mile, the limestone appears on the banks of the creek also. It is here a brittle, yellow limestone, thin bedded, and quite fossiliferous in places. One of the best exposures of this rock is on Mr. Stevens' place, at the old milldam, a few rods above the crossing of the wagon road from Aurora to Batavia. Here some layers are almost entirely made up of casts of *Pentamerus oblongus*, with very rarely a coral or other fossils.

Between this point and Batavia, although the ledges still continue along the base of the bluffs, there is but one exposure of more than a very few feet; a disused quarry, about a mile south of the latter place, which shows a perpendicular cliff of about twenty or twenty-five feet, all apparently of one bed of yellow or buff limestone. No fossils were afforded by this locality.

At Batavia, in the quarries on both sides of the river, the beds are precisely similar to and probably identical with those worked at Hoyt's quarry in Aurora. In Mr. Barker's quarry, on the western side of the river, there is about twenty-five feet of buff and drab limestone, overlaid by eight feet of the upper cherty layers; the line of division between the two is very distinct. This upper cherty portion of the rock appears in the exposure to be much shattered, but is consolidated again by a stalagmitic cement. It is altogether worthless as a quarry rock, and is very troublesome to remove. Throughout the greater part of the quarry, the strata lie horizontally, but at its northern end there is a sudden dip to the southward of from ten to fifteen degrees, bringing the lower beds to the level of the top of the quarry. On the opposite side of the river, the same dip is to be seen in Shannon's quarry, exactly where the strike would lead us to look for it. In the three principal quarries on the eastern side of the river, those of Messrs. Starkey, Shannon and Randall, respectively, the same lower beds are shown as at the one already mentioned on the western bank, but at Shannon's quarries only, are the upper cherty beds exposed. Near the bottom of this quarry there is also a thin stratum of bluish shaly limestone, and a seam, two or three inches thick, of sandstone, which is probably only local. A very noticeable feature in all of these quarries, is the presence of large, well defined, perpendicular joints, trending about E. S. E. and W. N. W. Another set of joints, at right angles to these, is less conspicuous. In Shannon's quarry, two of these joints, parallel to each other, enclose about ten feet in horizontal thickness of the strata, which is said to be shaly and entirely worthless for building purposes, while on either side are continuous strata of valuable stone. Fossils appeared to be exceedingly rare in these beds, and when found, except when in a silicified condition, are very indistinct.

Just north of the bridge, on the western side of the river, at Batavia, is a quarry, the rock of which is a light yellow limestone, very similar to that at Mill creek, and containing in one of its narrow layers great numbers of *Pentamerus oblongus*. The whole exposure is of about twelve feet. I consider this exposure, and that at Mill creek, as of a lower bed than those exposed in the six principal quarries at Batavia, which cannot be identified as appearing any more above the surface to the northward of that point.

From Batavia northward, the ledges may still be observed along the river bank. The rock is probably that of the lower beds, the upper ones may still perhaps be in place higher up in the bluffs, but if so, they are completely covered with soil, and invisible. Before reaching Geneva, however, the ledges disappear and are not again met with until that place is reached. On the eastern side of the river, a little north of the bridge, a quarry affords a section of about eleven feet, the upper five of which are of a yellowish limestone, similar to that already mentioned as occurring at Batavia and Mill creek. Under this, six feet of a white grayish stone is exposed, which is quarried for building stone. The upper bed affords a few *Pentamerus oblongus*, the lower one appears almost destitute of fossils. A lower bed of similar limestone, exposed on the river bank a little higher up, afforded a few corals and other fossils.

North of Geneva, the limestone may be observed outcropping at various points, and forming the bed of the river and several smaller streams. The best section which is afforded by any exposure between this point and St. Charles, may be seen at a place called Cedar Bluffs, about a mile south of the latter place. The two lower beds seem similar to those which are exposed further down the river, at Geneva:

		FEET.
1.	A thin-bedded buff and gray limestone, apparently destitute of fossils........ ...	7
2.	A bluish or bluish-white shaly bed..	1
3.	Brittle yellow limestone, similar to the upper bed at Geneva, and containing many *Pentamerus oblongus*, corals, etc...................................	4
4.	Bluish or grayish-white rock, containing a few fossils, *Illænus*, *Orthoceras*, etc., and resembling in appearance the lower bed at Geneva, exposed	3

Below the lowermost bed in this section, and the level of the river, is a considerable thickness of strata, which are not exposed well enough to enable us to judge of their lithological character. Much of it, however, is in all probability the same as No. 4. A half a mile farther north, at McAulay's quarry, the same beds are again seen, but, in this exposure, No. 1 is somewhat thinner, and

No. 4 thicker by five feet. Here, it also is divided into two strata, each four feet thick, not differing lithologically, but with a very distinct line of separation. At this place, I obtained from bed No. 4, in addition to the species collected at the other locality, *Calymene Blumenbachii*, *Pentamerus oblongus*, a *Cornulites*, and some additional corals. The quarry in the village of St. Charles, on the western side of the river, may perhaps be in another bed than those exposed here, as the stone seems slightly different; it, however, resembles No. 1, rather than the others, and is possibly identical with that bed.

At St. Charles, the rock disappears under the surface, and no exposures are met with, up the river, for nearly four miles. At this distance from the village, however, a slight undulation of the strata, or a low anticlinal, brings it again to the surface, and it is prominent, in perpendicular ledges and cliffs of low elevation for nearly a mile along the western bank of the river, and for a less distance on the eastern side. The exposures of the rocks of this group here consists of about twenty-five feet of the lowermost beds, resting immediately on the shales and shaly limestones of the Cincinnati group. The slope here is very slight each way, and indeed, but for the fact of the underlying beds of the Cincinnati group being brought to the surface, the disturbance of the strata would be hardly noticeable. The rock consists of intercalated beds of light gray limestone and buff colored dolomite, containing in the lower portion a few thin seams of chert. The light gray portions of the rock answer well for burning into quick lime, and some of the other beds seem to be suitable for the manufacture of cement. The axis of the disturbance is crossed by the road at Mr. Jucket's lime kiln, in the southwest corner of section 3, township 40, range 8 east, and its trend is about northwest and southeast. The Fox river is diverted from its course by this obstruction, and runs in a northwesterly direction along its northeasterly edge for about a mile, breaking through it and running again to the southward, in the southwestern part of section 3, township 40, range 8. But few fossils were obtained in the bed of the Niagara group at this locality, only *Stromatopora concentrica*, a Favosites, an Illænus, together with a few imperfect casts of gasterapod shells, and some indeterminate corals, being found.

North of this disturbance, exposures are also wanting along the river till the village of Clintonville, distant between two and three miles, is reached, where the rocks once more come to the surface. In the quarry here, on the western side of the river, a little above the village, in the southwest quarter of section 26, township 41, range 8, the same strata and order of superposition are observed as at Cedar Bluffs, below St. Charles, with the exception of the upper part of No. 1, only about ten feet of which is exposed. The thin shaly seam, No. 2, is also much thinner, having here a thickness of not more than five inches, and about three feet in thickness, immediately below, represent No. 3.

The remaining eight feet exposed, to the bottom of the quarry, represent No. 4. The whole thickness exposed is fourteen feet and five inches. The fossils are similar in species to those collected at the former locality, *Pentamerus oblongus*, *Halysites catenularia*, and various indeterminate casts of corals and shells. There is, at this locality, a very slight dip to the eastward, not more than one or two degrees. North of this point there are no exposures of the older rocks along the river within the limits of the county.

The only exposures of the Niagara group which remain to be mentioned as occurring within this district, are met with in the forks of Big Rock creek, in the southern portion of section 26, township 38, range 6, in the southwestern portion of Kane county. There are here two principal outcrops, one on each branch of the stream, and not more than a quarter of a mile apart. The bottom land lying between the two, is also underlaid at a depth of from two to four feet by the same rock, which has here been also artificially exposed at a point about midway between them. At the easternmost exposure, the rock is a soft ferruginous limestone, of a yellow, and, in some specimens, reddish color. At the diggings on the western fork, and in the bottom land, it seems less ferruginous and more compact and hard, and generally better fitted for use as a building and flagging stone. As nearly as could be made out, the strata were horizontal. The limestones here are hardly fossiliferous; such few specimens as were obtained, however, were identical with those found near the base of the formation elsewhere. On the creek below this point, no exposures are met with north of Kendall county line, though the rock is evidently not far beneath the surface.

Cincinnati Group.—The rocks of this group underlie a small area in the northern part of DeKalb county. As, however, they are exposed at only two or three points within this area, it cannot be defined with any exactness; it may, however, be approximately described as a narrow strip, extending into this county from the north or northeast, and having a width from east to west of probably not more than eight or ten miles. Its western border is probably somewhere near the west line of range four of townships east of the third principal meridian. South of the Kishwaukee, or Sycamore river, there are no outcrops in DeKalb county, its limits therefore cannot be well defined in that region, though it probably does not extend very far to the southward.

One of the few exposures of this group in the DeKalb county area, occurs on the north bank of the Kishwaukee, just north of Stewartsville, where about fifteen feet of interstratified green and blue shales and rotten limestone, with some more solid beds, were seen. The exposure continues only so far as the beds have been worked. Elsewhere the high banks of the creek present only grass-grown slopes. No dip was observed in this locality, nor were any fossils discovered except a few fragments of Trilobites generally undistinguishable as to species, on account of the incoherency and fragility of the material. The more solid beds were not rich in fossil remains; the only specimens found were fragments of *Calymene senaria*, and *Lingula*. A little over two miles from this point, near the middle of the dividing line between sections 17 and 18, or a little over into section 17, is another quarry into a yellowish, and in some parts reddish, porus limestone, almost entirely made up of undistinguishable organic remains, and containing also some well preserved fossils. The depth of the excavation was about five feet, with apparently no change in the character of the rock. About a quarter of a mile farther south, I observed another similar excavation in similar beds of limestone.

Mention has been made in the remarks on the Niagara group, of an isolated exposure of Cincinnati beds forming the base of a low anticlinal, cut through by Fox river, in the western part of section 3, township 40, range 8. No good section is afforded at this place, as a sloping, grass-grown talus extends almost uninterruptedly from the foot of the ledges of Niagara limestone to the level strip of bottom land along the river. The highest point to which this formation extends in the axis of disturbance, is about thirty feet above the river. The upper beds here appear to be shaly, containing many thin plates of a highly fossiliferous gray limestone, containing many of the characteristic fossils of this group. These are washed out abundantly in the small runs and water channels in the bank, and afford in great numbers *Orthis subquadrata*, *Orthis biforata*, *O. testudinaria*, *O. occidentalis*, *Strophomena alternata*, *Leptæna sericea*, and many other common species.

Trenton Group.—The upper beds of the Galena limestone, which alone are included in the surface outcrops of this district, underlie the surface in that portion of DeKalb county lying west of the area already mentioned as occupied by the Cincinnati group. The exposures are few and, with one exception, confined to the banks of the Kishwaukee and its immediate vicinity. The principal exposures are as follows:

Near the center of the western half of section 30, township 42, range 3, and about a quarter of a mile from the western line of the county, I observed, in a small ravine at the side of the road, a ledge of thinly bedded, buff colored, porous, fossiliferous limestone, which had been quarried to some extent, and was exposed in the natural and artificial section to a depth of about ten feet. No dip was perceptible in this exposure. The fossils were, from the nature of the rock, very imperfect, being principally very indistinct internal casts of *Murchisonia*, *Pleurotomaria*, etc. Similar beds of limestone are said to occur in the bed of the Kishwaukee, in the northern parts of sections 21 and 22, but at the time of my visit the water was too high to make any thorough examination.

Passing up the creek, we find again in the southeast quarter of section 42, similar ledges of brownish-yellow and buff colored limestone appearing to the hight of about six feet, on the north bank of the creek. Fossils were numerous at this place also, but were similar in condition to those in the locality previously described. One and a half miles farther east, in the western part of section 2, township 42, range 4, is another exposure, at which also the rock has been somewhat quarried. The limestone is worked right at the water's edge, and is said to appear also in the bed of the stream in this vicinity. The upper beds here are friable and thin; the lower beds, however, are said to answer well as a building material for the rougher kinds of work.

Economical Geology.

Building Stone.—The best stone for general building purposes which is found in this district, is that which is obtained from the quarries at Batavia and the southern part of the city of Aurora. This is apparently near the top of the Niagara group, as it is developed along the Fox river, though probably within one hundred feet from the base and actually in the lower part of the formation. It is probably in about the same geological horizon as the well known Joliet stone, which it very much resembles. It is here a light gray or drab, evenly bedded limestone, the beds varying from eight inches or less to nearly three feet in thickness, affording blocks of all sizes required for building purposes. The stone dresses well, is strong and durable, and after being cut is of an agreeable light drab or buff color, which, however, is liable to be considerably deepened by the action of the weather. Occasionally, also, some layers of the stone contain nodules of pyrites which, decomposing, leave unsightly stains on the walls and buildings in which it is used, as may be observed, for instance, in the court house at Geneva. This stone is used extensively for building purposes, not only in this district, but also in other parts of the State. The quarries at Batavia are worked in the side of the river bluffs, and the consequent necessity of removing the superincumbent masses of Drift and surface soil is a hindrance to their extension, causing a great increase in the labor and the expense of working them.

The other exposures of the Niagara group, and the limestones of the Trenton and Cincinnati groups, occurring in various parts of this district, also afford a supply of material suitable for foundations, rough walls, etc., and are also used to some extent for general building purposes. The rock, however, is generally too thinly and irregularly bedded to afford a superior quality of building stone, Large portions of this district, however, are entirely destitute of a local supply of building stone, and in some parts this material, whenever it is required, must be transported a distance of from ten to eighteen miles.

Limestone for Lime.—Many of the limestone beds of the Niagara group, in this district, afford a good material for the manufacture of lime, and have been worked for this purpose. Lime kilns have been established at Naperville and other places in DuPage county, and at several points along the Fox river, in the vicinity of the towns of Aurora, Batavia, Geneva, and St. Charles, in Kane county. In northern DeKalb county, the outcropping beds of the Galena limestone have been used for the same purpose, and are reported to have furnished a good article. The deposit of calcareous tufa, three miles north of the city of Elgin, and its former manufacture into lime, have been already mentioned in the earlier part of this chapter.

In the lowest part of the Niagara group, at Fayville, on the Fox river, about four miles north of St. Charles, there occurs a stratum of somewhat argillaceous magnesian limestone or dolomite, which it is reported has been tried and found to answer for the manufacture of hydraulic cement. An analysis of this rock, by Dr. Blaney, may be found in the appendix to the third volume of these Reports. Beyond this I am not aware of any material which has been tested for this purpose, within the limits of this district.

Other Building Materials.—Clay and loam suitable for the manufacture of brick may be obtained from the Drift and surface deposits in various parts of this district. The best material for this purpose, however, is found in the northern part of Kane county, at the village of Dundee. The clay here, which appears to belong to the Drift formation, is quite free from oxydes of iron, and burns into brick of a delicate pale yellow color, in assorted lots, not inferior in appearance to the celebrated Milwaukee brick. In other places, however, the same difficulty is met with as in Cook county; the clay contains too great a proportion of lime to produce at once a handsome and durable article of brick. Sand and gravel for mortar and concrete are sufficiently abundant in all parts of the county.

The limestone boulders and hard-heads, which are so abundant in various places along the Fox river, in Kane county, are also used to a limited extent as a building material, in ornamenting the fronts of houses, etc.

Peat.—Deposits of this material, of greater or less extent, are found in various parts of this district, but are most numerous and extensive in the northern portion of Kane county, where there are some rather extensive level, wet prairies. But little attention, however, has as yet been paid to the economical value of this material, and the depth and extent of the deposits have been scarcely tested. At the village of Carpenterville, on the Fox river, one mile north of Dundee, there is a deposit of peat one hundred acres or more in extent, and averaging at least four or five feet in depth, which has been somewhat used in the neighborhood as fuel, and found to answer well. Still more extensive beds occur farther west, in the towns of Rutland and Hampshire, which are reported to have also been used to a slight extent.

Agriculture, etc.—The principal varieties of soil, etc., in this district, were briefly mentioned in the beginning of the present chapter. The prairie soil, which covers the greater portion of the surface, does not differ from the average in this part of the State. It is always productive, and yields good crops by proper tillage. Although a few comparatively poor sections may be found, yet, as a whole, in the elements of material prosperity, it is not behind any other territory of equal extent in this part of Illinois. The nearness and the easy accessibility of most parts, by means of the several railroads, to the great commercial. metropolis of the northwest, adds greatly to its other advantages.

Water is readily obtained by sinking wells to depths varying from ten to fifty feet, and very rarely more. The supply here comes largely from water veins in the gravel beds or seams, which traverse the clays or hard-pans of the Drift. It is only in extraordinarily dry seasons that any inconvenience is felt in the want of a sufficient supply of water for stock.

CHAPTER VIII.

McHENRY AND LAKE COUNTIES.

These two counties are situated contiguously to each other, in the northeast corner of the State, and are bounded, respectively, as follows: McHenry county is bounded, on the north, by the State of Wisconsin; on the east, by Lake county; on the south, by Cook, Kane, and DeKalb counties; and on the west, by Boone county. Lake county, lying to the east of McHenry, has for its remaining boundaries on the north, east, and south, respectively, the State of Wisconsin, Lake Michigan, and Cook county. The superficial area of the whole district is about ten hundred and six square miles, of which area, the greater portion, six hundred and twelve square miles, is within the limits of McHenry county, and the remainder, three hundred and ninety-four square miles, in Lake county.

The principal streams by which this region is watered are, in the order of their importance, as follows: the Fox river, which, entering this district from the north, and passing through several expansions or lakes, traverses it in a general north and south direction; the DesPlaines, also rising in the State of Wisconsin, and pursuing a generally parallel course; the Kishwaukee, rising in the central and western portions of McHenry county, in two or three branches, and flowing westward into Boone county; and the Nippersink, a tributary of the Fox, also rising in McHenry county, and traversing several of its northern townships. Besides these streams and their lesser tributaries, there are one or two small water-courses discharging directly into Lake Michigan, and a slough, or succession of sloughs, in the southeast corner of Lake county, are drained by the northern branch of the Chicago river, which, in this county, can hardly be called a stream, except during the wet seasons. That portion of the district, however, which drains its waters into the lake, and may properly be said to belong to the basin of the St. Lawrence, is very inconsiderable, a mere strip along the coast, hardly averaging three or four miles in width.

The surface configuration of this district is somewhat varied, embracing not only the upland rolling prairie and woodland, the prevailing character of the surface in this part of the State, but also extensive wet prairies or sloughs, in certain localities, and tracts of alternate sand ridge and marsh of the most recent lucustrine formation. This last character of the surface, however, is confined to a narrow strip extending along the coast, from Waukegan northward, and in its widest part, not more than two miles across. The ridges here are composed almost entirely of sand, but nevertheless, support a growth of stunted black and red oak, dwarf juniper, and occasionally, white pine; their elevation is but a very few feet above the lake. The outermost one is the widest, and indeed, in many places, the only one, being constantly enlarged by accretions along its lake front, and by the loose sand blowing inland from the beach, which is itself a wide one, and is fronted by shallow water for some little distance from the shore. The low prairie or marsh, between the ridges and the bluffs, is overflowed in many portions during a great part of the year, and in some places is scarcely ever passable. In the firmer spots, there are occasional clumps or thickets of bushes and low trees, but over the greater portion, the only vegetation is rank grass and rushes. A strip of land of this general character, extends along the coast nearly to the State line, gradually rising, however, to the northward, and becoming dryer and more wooded.

This low coast does not extend south of Waukegan, and the bluffs, which, north of that place, are a mile or more inland, form the immediate coast to the southward, in many places without even a strip of beach between their bases and the water's edge. Being thus exposed, the bank crumbles rapidly under the wearing influence of the waves of the lake, and in violent storms, large masses are often undermined and carried away. Another frequent cause of landslides is, the water percolating the clay from the top of the bank downwards, which, when the frost is coming out of the ground, or after long continued wet seasons, must affect materially the rapidity of the process of degradation. The hight of the bluffs, however, some seventy or eighty feet, is such as to render the inward progress of the lake upon the land comparatively slow. The actual rate of wear could not be exactly ascertained, but from the appearance of the clay bluffs themselves, I judged that in the course of years it might be considerable, amounting, perhaps, to several hundred feet in a century.

Inland from the bluffs, we find, for several miles, a gently undulating surface, which, for the most part, was originally covered with a heavy growth of timber, principally of the different species of oak and hickory, with a sprinkling of other kinds of trees. The soil is a light colored, somewhat arenaceous clay or loam, with more or less admixture, in its upper portion, of organic matter, rendering certain portions slightly darker in color than the remainder. The same general character of the soil prevails in the undulating timbered tracts in all parts of the district, and also forms the subsoil of most of the prairie. It appears to me to be a somewhat modified upper member of the Drift, and may be seen with the same general characteristics, in similar situations, in all of the northeastern counties of the State.

Passing still further westward in Lake county, the general appearance of the country is found to be the same, undulating prairie and forest, with here and there over the surface, small level prairies and lakes or ponds. These latter are most numerous in the western and northwestern portions of the county, where they are extremely abundant and vary in extent from a few acres to several square miles. The largest are those on the upper course of the Fox river, near the McHenry county line, Pistakee Lake and Fox Lake, which are from four to seven miles in length, and a mile or more in breadth. The others seldom exceed one or two square miles in area, and vary in character from quiet land-locked ponds to shallow, grassy marshes, differing but little from the ordinary wet prairie or slough. Indeed, almost every intermediate form between the two may be found in this region. The larger lakes, in many instances, are themselves widely margined with a growth of wild rice and various aquatic grasses and weeds, the matted stems of these, together with the floating confervoid vegetation, forming, in some places, a mass of sufficient buoyancy to support the weight of a man. When, however, this mat is once penetrated, a stick or an oar may sometimes be thrust down for a depth of several feet, meeting with scarcely any more resistance than is furnished by its own buoyancy. There are in Lake county, including the smaller ones, some twenty or thirty of these lakes or ponds; their average extent is, perhaps, nearly one square mile.

Passing westward into McHenry county, we find much of the surface of the same character, but also a much greater proportion of prairie, both level and undulating. The wooded country becomes more broken, even rising in some instances, into what may be called in this part of the country, hills of moderate elevation. The general characters of soil and timber continue about the same; the small lakes, however, so characteristic a feature in the adjoining county, are scarcely met with at all to the westward of the Fox river. The prairies of this county, which, including under this head the low-lying marshy tracts or sloughs, comprise probably two-thirds, or a still greater proportion of its surface, show in themselves rather greater variety of soil and surface than those in the counties farther to the south. We have here the gently undulating or rolling prairie, a continuation of that of the counties lying to the south and west, with its dark brown or blackish upper soil of varying depth, with a sandy or gravelly clay sub-soil, and with narrow strips of marsh or slough between the undulations. This is the general character in the southern tier of townships, and to a considerable extent, though less generally, in other parts of the county. In the central, and in some other portions of the county, the surface of the prairie sometimes becomes less undulating, and even apparently level, though still preserving sufficient rise to afford good drainage. A good example of this variety of prairie surface may be well seen in the Kishwaukee prairie, and at one or two other places in the county. Lastly, we have the before mentioned wet prairies, or sloughs, which combined, occupy a considerable area in this county. Small sloughs, varying in extent from one acre or less to several hundred, are found in all parts of the county, but the largest are in the northern tiers of townships. The soil of these wet prairies is generally more or less peaty, varying in composition from ordinary black, swamp muck to true peat; its depth varies from one to twelve feet, and is sometimes even more.

The geological formations in this district comprise only the Drift, and of the older rocks, the Cincinnati and Niagara groups. The latter, however, are exposed at only two or three points in the district, everywhere else being deeply buried under the deposits of the Drift. These consist here, chiefly of clay and hard-pan, with occasional beds of sand, gravel, etc., and with frequent boulders scattered throughout the mass. Its depth over the whole district will probably average at least seventy feet, being seldom less than that, and often much deeper. The best section is afforded along the lake shore, from Waukegan southward, where the exposed face of the bluffs, washed by the lake waves, and constantly exposed to their wearing action, presents an almost continuous section of from sixty to eighty feet perpendicular, for twelve or thirteen miles. In most places these bluffs appear to be entirely composed of clay and hardpan, without stratification or any horizontal arrangement whatever, except in having the upper portion generally of finer material than the lower, as was observed in the continuation of these same bluffs southward, and mentioned in the report on Cook county. In some places, however, a kind of a rough stratification may be seen, rarely extending any considerable distance, and often so indistinct as to escape the notice of a casual observer. In the bluffs near Port Clinton, I observed the variation of the beds more by observing the line of springs, or the level at which the most of the moisture seemed to gather in the face of the bank, and to some extent also by the same means farther to the northward. At one point, a little north of the City of Lake Forest, I made out the following section. As the cliff was nearly perpendicular and unscalable, the thickness of the different beds are merely estimates, their relative thicknesses, however, are comparatively unimportant, as at no two points were they exactly the same:

	FEET.	IN.
1. Clay	10 to 14	
2. Sand and clay intermixed	9 " 12	
3. Clay	1 " 1	6
4. Sand	1	
5. Clay	50	

I could not trace this section for more than a few rods along the face of the bluffs, as the different beds appeared to run out or to graduate into each other in such a manner as scarcely to be detected. Farther to the northward, between this place and Waukegan, I noticed bands or strata of different colored clays in the upper portion of the bluffs at one or two points.

Irregular pockets of sand and gravel, sometimes with a kind of rough stratification of the contained material, and large and small boulders of nearly all kinds of rock, are scattered abundantly throughout the hard-pan and clay of which the cliffs are mainly composed. One of the largest of these boulders was seen on the beach at the foot of the cliffs, a little north of the southern line of Lake county. The material of the mass is a light blue or drab colored, close grained, impure limestone, containing a few silicified crinoidal stems, etc., but not enough of fossil remains to determine the age of the beds from which it was derived, though it is probably from some of the silurian rocks of Wisconsin. Its dimensions I was unable to take with accuracy, as it was deeply bedded in the sand and partly covered by a land-slip from above, but the exposed portion was about ten feet by six or seven, on its upper surface, standing three or four feet above the beach. Its upper surface was polished, but not level, and showed striæ in nearly all directions, but with the deepest ones and largest number in the direction of its greatest diameter. Other smaller masses of the same rock are frequently found with two or more sides flattened and striated, and it seems quite possible that this larger mass, if fully exposed, might show other similar striated surfaces to the upper exposed one. Most of the large boulders are of limestone, the masses of the primary or intrusive rocks are generally of comparatively small size, or when of considerable size, are but rarely met with.

Passing away from the immediate vicinity of the coast, where the frequent deep ravines afford an occasional view of the lower clays, we find no good sections of the Drift in Lake county. There are no natural exposures, and all the data which can be obtained from wells, etc., are meagre and unsatisfactory; they seldom penetrate more than forty feet, and but little is met with but blue clay or hard pan, with an occasional pocket or irregular seam of quick sand or gravel. Boulders, however, are tolerably abundant on the surface, and are also met with in these excavations, many of them of considerable size and weight, and of nearly every material, granite, syenite, greenstone, trap, etc., as well as of the more recent sedimentary rocks, such as limestone and sandstone. In the western part of the county, near the Fox river, we find the ridges, in some places, to be largely composed of rolled limestone boulders. The same character has been observed further south along the same stream, and remarked upon in the chapter on Cook county. The material, judging from the lithological characters and contained fossils, is chiefly derived from the beds of the Niagara group, to the northward, in the State of Wisconsin.

In the northeastern part of Lake county, along the bluffs north of Waukegan, the Devonian beds of Wisconsin appear to have contributed largely to the debris of the Drift; in a collection of fossils, all more or less worn but mostly recognizable, which had been picked out of the gravel beds of this region by Mr. J. W. Milner, a very enterprising and zealous resident collector, I noticed a very large proportion of Devonian species, apparently of the age of the Hamilton group.

In McHenry county, we find this formation presenting much the same general characters as further to the eastward. In the vicinity of the Fox river, the same kind of gravel ridges are met with as those which have been described as occurring in the western part of Lake county. In the central and western portions of the county, the mass of the Drift appears to consist of clay and hardpan, with occasional boulders. We have, however, in this county, accounts of logs of wood and other vegetable remains being found at various depths in these deposits, a feature which appears to be wanting, or extremely uncommon in Lake county. One such instance of the finding of a cedar (?) log seven inches in diameter, at the depth of forty-two feet below the surface, is reported, on the land of Mr. Thos. Duffield, near the eastern line of section 13, township 44, range 6. Other instances are reported in various parts, at depths varying from fifteen to fifty feet or more. Such of these tree trunks, etc., as are found within fifteen or twenty feet of the surface may, perhaps, belong to a later period than that of the mass of the Drift, but those which are met with at depths of forty or fifty feet, or even more, cannot, it seems to me, be properly so referred.

Niagara Group.—This formation, probably, underlies the whole surface of the district, with the exception of a narrow strip along its western border; its outcrops, however, are limited to two or three localities. For this reason, therefore, its boundaries can be determined only approximately, by lines drawn from localities beyond the limits of the district. The outcrops, judging from the character of the rock, appear, with perhaps one exception, to be confined to the upper or middle portion of the group, and are as follows:

In the northwest quarter of section 31, township 44 north, range 11 east, on the land of Mr. Thomas Rawson, a ledge of light gray limestone, weathering to a pale yellow or buff color, has been opened to a limited extent. The exposure is not natural, the top of the ledge having been originally covered with earth to the depth of about a foot or eighteen inches, and was only discovered as late as the year 1867. The depth of the excavation is about six feet, the rock showing no signs of stratification whatever, but becoming rather darker in color and more dense in the lower part of the exposure. Although in its upper portion the stone seemed to be almost entirely made up of disintegrated organic remains, but few fossils were collected, a few corals and an internal cast of

Caryocrinus. A half a mile west of this point, in the northeast quarter of section 36, of the adjoining township, the same limestone is said to have been met with at the depth of four feet.

About five miles due north of this locality, in the northwest quarter of sec. 1, on Mr. Watson Convers's place, a bed of limestone rock was struck in two separate places, in digging wells, in one at the depth of only five and a half feet below the surface. A few flakes of the stone were turned up and were to be seen on the surface at the time of my visit; a rather even textured, light drab or buff limestone, containing imperfect casts of *Pentamerus.* If this limestone is here in place, and judging from the account of Mr. Convers, I think it quite probable that it is, it may, perhaps, belong to a considerably lower horizon than that of the other localities in the district. In general appearance, the specimens of the stone which were seen were not very different from some of the beds exposed on the Fox river, in Kane county, which were there referred to the lower part of the group.

The only remaining locality where the beds of this age have been exposed at the surface, is in the northeast corner of section 17, township 44, range 9, and nearly on the county line between McHenry and Lake counties. The limestone is here seen in the sides and bottom of a shallow excavation on the roadside, about ten or fifteen feet in diameter. In general appearance and texture, it is the same as that at Mr. Rawson's, except that at this point, being somewhat more exposed to atmospheric and other wearing influences, it is softer and more disintegrated. No well preserved fossils are contained in this rock; a few imperfect casts of corals and crinoids, and a single specimen of *Strophomena rhomboidalis* were only obtained.

At a place called the Sand Hills, on the Kishwaukee, in the southwest part of section 21, township 44, range 6, a bed of limestone was reported to have been struck at the depth of fourteen feet below the surface. This, also, probably belongs to the Niagara group, as we have no reason to infer that the other formations extend so far to the eastward.

Cincinnati Group.—This formation, as nearly as we are able to judge, underlies a narrow strip of territory running nearly due north and south, near the western border of this district. Its exposures are restricted to one locality, about two miles east of Garden Prairie Station, on the Chicago and Northwestern railway, Galena division, and about a quarter of a mile south of the main wagon road, between that place and Marengo. It is here extensively quarried, the excavations being twelve feet or more in depth. The rock is a thin bedded, buff limestone, having frequently a slight bluish tinge, and containing much chert in some parts of the quarry. In general appearance, it is very similar to some of the lower beds of the Niagara, to which group I was at first inclined to refer it. Fossils appeared to be scarce, only a few imperfect fragments were obtained.

It is just possible that I have drawn the dividing line between the Niagara and Cincinnati groups too high up, and that these beds should properly be considered as forming the base of the upper Silurian. In referring them, however, as I did, I was influenced by their resemblance to undoubted Cincinnati beds, farther to the westward, as well as by the position of the outcrop. We frequently find, moreover, in this part of the State, a greater or less similarity in the beds on both sides of the line of separation of two members of the Silurian, lying conformably one upon the other, and occasionally what appear to be beds of passage between the two.

Besides the Niagara and Cincinnati groups, which we know to underlie portions of the territory of this district, the Galena limestone may possibly be also found to occupy a very narrow strip along its northwestern border. As, however, I am aware of no outcrops nor exposures, whatever, of this formation, in the district, and its presence here is only inferred from the facts afforded by the exposures in the adjacent portion of Boone county, directly to the westward, this bare mention of it may be sufficient in this report.

Economical Geology.

Building Materials.—The only stone quarry of any extent within the district, is that which has just been described under the head of the Cincinnati group, a little distance east of the western line of McHenry county. The rock here is generally too thin bedded and contains too much chert, to serve all purposes as a building stone, but nevertheless answers well for foundations and for the rougher kinds of masonry generally. In the other localities where the beds of rock appear, they have been worked only to a very slight extent, and for the manufacture of lime alone. It does not appear, moreover, from the nature of of the rock itself, that any very good building stone will ever be obtained from the most of these outcrops. In many parts of the district, the erratic boulders of the Drift are used more or less in rough masonry, and in some places along the Fox river, boulder quarries, so to speak, are worked in the ridges which have been mentioned before, as being largely made up of loose masses of limestone rock.

Good clay for making brick is found in most parts of the district, although in some instances the same difficulty is met with as in Cook county—the clay contains too large a proportion of lime or limestone pebbles to make a good article. The prevailing color of the brick made in this district is red or reddish brown. A white or straw-colored brick is made, however, at Woodstock, and at McHenry, in McHenry county. At Woodstock the clay from which the white brick is made is obtained under a peat bed, and may possibly be a sedimentary formation, more recent than the Drift. That at McHenry I am inclined to think belongs to the Drift proper. The same clay that is used for making the white brick at Woodstock, is used also for the manufacture of drain tile, and is said to answer well.

Lime is burned from the limestone boulders, which are abundant in many parts of the district, and has also been manufactured from some of the limestone outcrops, but no very extensive manufacture of it has been attempted in either of the two counties. Sand and gravel, for mortar and concrete, are generally sufficiently abundant in all parts of the district.

Peat.—This material is found, in a greater or less extent, in all parts of the district, but the most extensive deposits are found in its northern half. The different bogs or sloughs in which these deposits exist, are so numerous and scattered that it is difficult to give more than an approximate estimate of the area they occupy. Perhaps, taken altogether, four or five thousand acres would be a sufficiently low estimate. Only a few of the sloughs have been at all examined as to the quality and depth of the beds.

One of the largest of the sloughs is that which may be seen in sections 7 and 8, township 46, range 7, a little north and northeast of Hebron station on the Rockford and Kenosha division of the Northwestern railway. From this point it extends, with some interruptions, several miles in a general southwest direction to the Nippersink, and probably occupies altogether an area equal to two or three square miles. The depth, when I was able to observe it, averaged from six to ten feet; the peat ranging from a light, fibrous substance, of a reddish brown color, to a denser dark colored material, of a considerable specific gravity, when dried.

Most of the other sloughs are of comparatively small size, varying from one to two or three hundred acres in extent. In the eastern part of Lake county, the low and marshy tract along the shore of Lake Michigan, north of the city of Waukegan, includes in its area a large proportion of peat bog, much of it of considerable depth. A very large proportion of the area in the district, now occupied by these deposits of peat, is so situated as to be capable of drainage, and nearly all can be made use of to a greater or less extent for the purpose of pasturage, etc.

In regard to the value of the material as an article of fuel, we have the testimony of those who have used it, generally in its favor. It has been used to a considerable extent in the brick and tile works of E. B. Durfee, Esq., at Woodstock, both in the kilns and in the furnace of a stationary steam engine, and in both cases is reported to have given entire satisfaction. I am not aware of its having been made use of for these purposes at any other place in the district, but it has been used, to a greater or less extent, for domestic firing, in various parts, and is generally said to answer well. It use, however, in most places, has been only experimental as yet, and it will probably be a long time before it will come into general use as a fuel, even in limited districts. In some portions of the district, this material has been used to a slight extent as a fertilizer, and when composted with other substances and allowed to stand for a season before using, it has been found beneficial to some of the varieties of soil.

None of the more useful minerals have as yet been discovered, in any quantity, in this district, nor is it probable that any extensive deposits will ever be discovered. The soil, however, is generally productive, and the lands in all parts of the district are generally readily accessible to good markets. Timber is generally abundant, and, except in the vicinity of the several railroads, scarcely less so than when the country was first settled.

In closing this report, I must here express my indebtedness to various citizens of McHenry and Lake counties, and especially to Mr. J. W. Milner, of Waukegan, for kind assistance and information voluntarily afforded during the prosecution of the field work in this region.

CHAPTER IX.

KENDALL COUNTY.

Kendall county is bounded on the north by Kane county, on the east by Will county, on the south by Grundy county, and on the west by LaSalle and DeKalb counties. It comprises an area of nine townships, or about three hundred and twenty-one square miles, of which about one-sixth is wooded and the remainder is prairie. It is watered by the Fox river, which traverses the northern and northwestern portions of the county, and by several smaller streams, the largest of which are the AuSable and its branches, the Blackberry, Big Rock and Little Rock creeks. The water supply of three streams, in this county, is chiefly derived from surface drainage, and to a very limited extent only, from springs, therefore the smaller ones are nearly or quite dry during seasons of drouth.

The general character of the surface of the country in this county, is that of an undulating prairie, with the timbered portion either in isolated groves, or skirting the principal streams. Sloughs, or flat damp meadows, frequently occupy the hollows between the high rolling prairies, but are not often of any considerable extent. It is in these sloughs that most of the streams which head in this county take their rise. Along the Fox river, which flows in a valley one hundred feet or more below the general surface, the country is more broken. The alluvial bottom lands along this river, are nowhere of any very considerable extent, being seldom of more than half a mile in width, and, for much of its course through this county, the Fox runs through precipitous banks coming to the water's edge, without even a narow strip of bottom land.

The principal varieties of timber found in this county, are similar to those in the adjoining counties. On the uplands we find the woods consisting chiefly of black, white, red, and burr oak, shell-bark and bitternut hickory, black walnut, butternut, white and slippery elm, white ash, iron wood, white and sugar maple, and on the lower grounds, in addition to the most of these, we find black ash, cottonwood, and occasionally a sycamore. The red cedar is also frequent along the banks of Fox river, though it forms no large portion of the timber. The undergrowth is pretty constantly of hazel, with wild plum, crab-apple, and other small trees. The soil of the timbered tracts is generally light colored, sometimes sandy, or gravelly clay, often somewhat darkened in color by an admixture of vegetable matter. On the prairies, the soil is mainly a dark colored mould, but containing in some places a proportion of sand and clay, especially near the borders of the streams and woods. The depth of this soil varies from one to three feet.

The deposits of the Drift epoch in this county, are in all respects a continuation of the region adjoining on the north, and over the greater portion of it, will probably average very nearly the same thickness, viz: from fifty to one hundred feet. In the extreme southern portion of the county, there are districts where these deposits are comparatively quite thin, but over by far the greater part, they are seldom passed through by even the deepest wells. Excepting the Fox river, and the AuSable, none of the streams cut down to the older rocks for any great part of their course, although they sometimes have cut ravines sixty or eighty feet belew the general level of the country. The beds of this age consist here, as elsewhere, of blue and yellow clays and hardpan, with occasional seams of quick-sand and gravel, and frequent boulders. In two places in this county, I have noticed faint glacial striæ on the exposed surface of the underlying beds of the older rocks. One of these was on Big Rock creek, near the southern half of section 1, township 37, range 6 east, where the top of the uppermost strata of an exposure of Niagara limestone was worn smooth and covered with faint scratches, running in the direction south 60° east. The other locality, was in about the center of section 9, township 35, range 8, where a ledge of limestone of the Cincinnati group, appears in the bed of the AuSable creek. At this point the direction of the striæ was different, being about southwest.

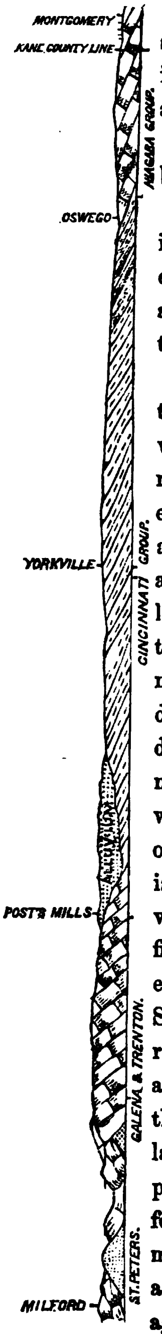
Along the Fox river, the materials of the Drift appear to have undergone a sifting, and reassorting process, by the action of the river, the bluffs frequently presenting sections of roughly stratified sand, coarse gravel and boulders, with sometimes a bed containing fossil fresh water shells of existing species. A good section of this modified Drift material, is afforded by the cutting down of the bluff for the grade of a road near the center of section 4, township 36, range 6, about ten and a-half miles south of Plano, where also a bed of shell marl is to be seen, intercalated between very irregular layers of sand, gravel and limestone boulders.

Of the older geological formations, we have the following named in descending order:

1. Coal Measures.

2. Niagara Group. Buff, drab, and brown impure limestones, with frequent nodules of chert. Aggregate thickness in this county, probably between fifty and seventy feet.

3. Cincinnati Group. Gray and bluish limestones, with green and blue shales. Total thickness, not over two hundred feet.



4. Galena and Trenton Limestone. Porous yellowish limestone, with some bluish beds near the base, and beds of passage into the next formation below. Total thickness estimated at about two hundred feet.

5. St. Peters Sandstone. Very incoherent white sandstone, brought up by anticlinals.

The accompanying reduced section, taken along the Fox river in its course through this county, shows all of these formations, except the first. The only outcrops of the St. Peters sandstone, are where it is brought up by anticlinals on the lower course of the river in this county, as represented in the section.

The coal measures probably underlie a small area of not more than three or four square miles in extent, in the extreme southwestern corner of the county. The underlying rocks are nowhere exposed above ground in this vicinity, but the existence here of deposits of this age, is inferred from the strike and dip of the exposures in the adjoining counties of LaSalle and Grundy, and not from any evidence afforded within the limits of this county. It seems highly probable, however, from the fragments of coal, etc., found in this Drift, that at one time most of the southern portion of Kendall county was overlaid by deposits of this age, which have been carried off by erosion during the Drift period, and it is possible that small outliers may still exist, under the heavy bed of Drift clay and gravel which overlies nearly the whole surface of the county. The only exposure which can in any way be referred to this period, is in the northeast quarter of section 16, township 35, range 8, very near the section line between sections 15 and 16, where we find a thin bedded bluish sandstone, overlying the gray fossiliferous limestones of the Cincinnati group, in the bed of the Au-Sable at this point. The sandstone can be traced for only a few rods, and the exposure is in no place good, it being generally almost buried in mud and water. In making an excavation on the bank of the creek at this point, Mr. House, the owner of the land, found many fragments of coal, with fire clay, and fossil plants, underlying a yellowish rotten limestone reported to be four feet thick, which seemed more like a mass of loose fragments washed together, than like a bed of rock in place. About a mile north of this point, the rocks of the Cincinnati group again appear, no intermediate exposures being seen.

Niagara Group.—This formation, judging from the outcrops, occupies a considerable area in the northern and northeastern portion of the county. From the scarcity of outcrops, however, it is difficult to bound this area with exactness, the junction between it and the next, being only seen on the Fox river at Oswego. Its southern border may be approximately represented by a line entering the county in the northeast corner of section 18, township 37, range 6, and running in a direction a little south of east, to the Fox river, at Oswego, then bearing gradually more and more to the southward, until it leaves the county in the southeastern corner of township 36, range 8. The general direction of this border line of the formation, is inferred from widely separated outcrops, some of them outside of the limits of Kendall county.

At Esq. Shontz's quarry, on Big Rock creek, near the centre of the southern half of section 1, township 37, range 6, about twelve feet of the regularly bedded light buff, or drab limestone of this group is exposed. It here contains much chert in irregular seams and concretions, especially in the lower part of the exposure, the upper two or three feet being almost entirely free from this substance. Above the quarry, at the milldam, this rock forms the bank of the creek, in ledges rising some seven or eight feet above the water, and may still be seen above water for about thirty rods above the dam. Farther up stream, the rock continues under the bed of the creek to beyond the county line, but is not again exposed in the bank in this county. Below the quarry, it appears in the bed of the creek for between a quarter and a half a mile, before finally disappearing entirely, and at several points within this distance, there are limited exposures in the banks. In none of these exposures is there any noticeable dip of the strata, and the level surface of the upper beds in the quarry, is covered with the glacial striæ, which have been already mentioned in the preceding pages. Fossils are not abundant in any of these localities, but *Halysites catenularia*, *Favosites favosus*, *Calymene Blumenbachii*, an *Illænus*, and a few other species were collected.

Eastward from this point, no prominent exposures or ledges of rock are met with, until the Fox river is reached. At the point where the river crosses the Kendall county line, just below the village of Montgomery, a ledge of yellowish limestone containing much chert, appears on the right bank of the river, rising to a hight of seven or eight feet above the water's edge. From this point down stream nearly to Oswego, there is very little exposure, the rock appearing only below high water mark, and in the bed of the stream. Just north of the village, near the southern line of section 8, township 37, range 8, the thin bedded limestone of this group is quarried in the bottom and sides of a small ravine. The lower eight or ten feet of the rock, which is quarried near the river bank, is mainly of a light buff color, with some portions of the strata approaching to gray, and with a few thin seams of bluish cherty rock very nearly resembling true chert in appearance, and breaking with its conchoidal fracture. Farther up the ravine, we find above this, six or seven feet of a rather darker colored, thin bedded limestone exposed. No fossils were obtained from any of the beds in this locality.

Across the river from this point, there is a rather more extensive quarry in apparently the same bed of limestone, which is worked, both for building stone, and for material for the manufacture of lime.

In the village of Oswego, in a perpendicular face of rock on the bank of Waubansia creek, a few rods below the bridge, about five feet of the lowermost beds of the Niagara limestone may be seen, resting directly upon the strata of the Cincinnati group. The rock here is a brownish, ferruginous limestone, and contains a few fossils, chiefly corals, *Stromatopora concentrica*, and a *Zaphrentis*, being most abundant. Thin seams of chert traverse the rock here, as in the other localities. The dip of the strata here is to the eastward, about three or four degrees, thus bringing to view a greater thickness of these beds further up the stream. A little above the bridge, near the lime kiln, and still farther up, there cannot be less than twenty feet in exposed vertical thickness, of the Niagara limestone, in the sides of the ravine.

The only remaining exposure of rocks of Niagara age in this county, is on Waubansia creek, in the northern part of section 16, a little over a mile from Oswego. At this point, the rock underlies the prairie at a very slight depth, over an area, probably, of several acres, and is exposed in the bed of the creek, and in the artificial excavations of the quarries. This exposure is of a light buff or drab, thin bedded limestone, containing some shaly layers. It also contains, in some of the upper layers, many small nodules of iron pyrites. The whole depth of the excavations in the rock at this place, was not more than four feet at the time of my visit, and for this reason I could not compare this exposure with some others in this county, as satisfactorily as I could wish, but I consider it as higher in the formation than any of them, probably fifty feet or more above the base.

Fossils were neither abundant or well preserved at this locality; a few fragments of Trilobites and corals only, were collected.

Cincinnati Group.—This formation occupies a considerable area, lying south and west of that underlaid by the Niagara group, equal, perhaps, in extent to one-third of the whole superficial area of the county. Its western border would, perhaps, be nearly represented by a line running from north, northwest to south, southeast, and crossing the Fox river in the southeast quarter of section 35, township 37, range 6. The line of junction between it and the formation next below, is not shown anywhere in Kendall county.

The upper beds of this formation are well exposed at Oswego, directly underlying the lowermost strata of the Niagara group. The following section of these beds, was taken on Waubansia creek, in the same place which has been already noticed as a locality of the Niagara lower beds. Commencing at the base of the Niagara limestone, about five feet below the top of the bank, the strata were as follows:

		FEET.
1.	Gray, or bluish gray limestone, with chert, apparently destitute of fossil remains	3
2.	Gray limestone	7
3.	Soft bluish shale	1
4.	Gray limestone	2

A little farther down the creek, the gray limestone, (No. 4), is better developed, and contains many fossils. The rock is a hard, sub-crystalline, thin bedded limestone, with even, thin shaly layers, and is considerably quarried at this point, as a material for the rougher kinds of masonry. The most abundant fossils in this locality are, *Tentaculites Oswegoensis*, *Rynchonella capax*, *Orthis occidentalis*, *Orthis bellarugosa*, *Strophomena alternata*, *S. deltoidea*, *Chætetes petropolitana*, and various crinoidal remains. On the opposite side of the river from the village, at the western extremity of the bridge, there is also an exposure of about twelve feet in vertical thickness, of thin bedded, grayish limestone, containing, at this point, considerable chert in lenticular and irregularly flattened masses. It has been quarried here to some extent, and has afforded some very fine crinoids. These same beds of grayish, cherty limestone, continued to be exposed in ledges near the water's edge, on both sides of the river, for some little distance below the bridge, but are not quarried elsewhere.

Below Oswego, along the Fox, the beds of the Cincinnati group, with occasional interruptions, continue to appear in the bank of the river. The exposures are of shale, with thin beds of limestone more or less abundant, and in many places, indeed, the limestone forms the greater part of the outcrop, the shale only appearing as partings between the thin beds of stone. In a few places, the exposures consist entirely of bluish shale, as, for instance, in the bed of Morgan creek, in the southeast corner of section 27, township 37, range 7. The beds of limestone are rarely sufficiently heavy to afford a good material for building, and are therefore worked in very few places. The thin plates of limestone are often covered with the more abundant fossils of this formation, as, *Rhynch. capax*, *Orthis occidentalis*, *Orth. testudinaria*, *Leptæna sericea*, *Strophomena alternata*, *Chætetes*, etc. At Yorkville and Bristol, these thin beds of limestone are exposed at the ordinary stage of water, along the bank of the river, and contain the same fossils as the exposures above.

At the milldam, on Blackberry creek, in the village of Bristol, about ten feet perpendicular of grayish, crystalline limestone, with some hard, bluish, shaly rock, is exposed. About thirty rods above, on the southern bank, is a small quarry, in which about four feet of the limestone is exposed. The beds of this limestone are here of sufficient thickness to afford a tolerable material for foundations and rough walls. Its color is a dark grayish blue, on weathered surfaces, sometimes appearing buff or brown. In this locality, besides the species already noticed as abundant in other beds, there are found many large *Orthocerata*, and a great abundance of *Ambonychia*, together with numerous fragments of *Trilobites*. The limestone, with some intercalated beds of bluish shale, continues to appear in the bed of the creek for upwards of half a mile above this point, before it finally disappears under the Drift.

Below Yorkville and Bristol, I observed ledges of this formation continuing, with occasional interruptions, along the banks of the river for nearly three miles, and presenting much the same appearance as those already described, as occurring along the river above Yorkville, but with, perhaps, a greater predominance of shale, as compared with the limestone. Just below Yorkville, the river bank shows from fifteen to twenty feet in vertical exposure of crumbling shale and rock, and an equal amount may be observed at other points below. Some of the thin layers of rotten limeston at this exposure, are extraordinarily rich in certain species of fossils, chiefly Trilobites, *Calymene senaria*, *Asaphus*, etc. The last appearance of these beds, down stream, is at a point not quite three miles below Yorkville, in the southwest quarter of section 36, township 37, range 6.

The outcrops of this formation which remain to be described in this county, are on the AuSable creek, in township 35, range 8. The intermediate prairie is entirely destitute of outcrops, and, except in the immediate vicinity of the AuSable and Fox, no rock in place has been reached by any artificial excavation. The northernmost of the outcrops of this group on the AuSable, occurs in the bed of the creek, very near the center of section 9, and is only visible at low water. The ledge, which is of very limited extent, is of an apparently massive gray crystalline limestone, containing a few characteristic fossils, among which I noticed *Rhynchonella capax* and one or two other brachiopods. The upper surface is smooth, and covered with faint striæ, which have been already noticed in the remarks on the Drift of this county. The next appearance of the rocks of this age, is at the crossing of the county road, on the center of the western line of section 15. Here the bed of the stream at the ford, and for a few rods above and below, is composed of a thinly-bedded, highly fossiliferous, light gray limestone, the beds dipping slightly (8° or 9°) to the northeast. The fossils here are the same as in the other localities described. About half a mile, in a direction a little east of north, from this place, on the southwest quarter of section 10, limestone, apparently the same as that exposed in the bed of the AuSable, was reached at a depth of ten feet, in digging a well.

In the bed of the AuSable, near the southern line of section 15, a dark colored shale, or shaly limestone, is exposed, which affords many fossils. A little further down stream, at the ford and below, the bed of the creek is composed of a bluish-gray, thin-bedded limestone, which is likewise fossiliferous. By a boring which was made by Mr. Durst, at his place, near the center of the western line of section 22, and half a mile from the creek, the following section was afforded :

		FEET.
1.	Surface soil and clay	7
2.	Hard, bluish-gray limestone—reported by Mr. Durst to be the same as that occurring at the crossing of the AuSable, half a mile west	17
3.	Hard, thin-bedded, bluish limestone, with shaly partings, said to contain, in its upper portion, about two inches of black, coaly matter, probably bituminous shale	54

I have not positively identified the lowest beds (No. 3) of this section, in any of the surface outcroppings along the creek, although they probably appear at some points in its bed farther down stream, in this or the adjoining county.

Below this point, the rock does not appear continuously in the bottom and banks of the stream, but is covered in most places with mud and gravel. The nearest points where it appears prominently in the bed of the creek, are the southwest corner of section 23 and the center of section 27. In both of these places, at the time of my visit, the stage of water was such that the strata were not visible, but, from pieces thrown out upon the bank, I considered the rock in this place to be the same as that in the localities above named. Further down stream, at the crossing of the old stage road from Joliet to Ottawa, just west of the center of section 34, I observed ledges of thin-bedded limestone appearing in the bank, to the hight of three feet or more above the water. The upper beds are light gray, inclining to a buff color, while some of the lower layers are dark gray and bluish. At the county line, a half mile further south, rock again appears in the bed of the creek—a highly fossiliferous, bituminous limestone, dark colored, almost black on freshly fractured surfaces. The general dip of the strata, in all these localities, is toward the northeast, although it is so slight as not to be everywhere apparent.

Trenton Group.—This formation, consisting, as has been stated, of heavy-bedded, yellowish and blue limestone, occupies all of that portion of the county which has not already been described as underlaid by the more recent formations, with the exception, perhaps, of a very small fraction of township 35, range 6, in the southwestern part, which may be underlaid by the St. Peters sandstone. Its outcrops are confined to the banks of Fox river, and a small area in the southern part of the county, in township 35, ranges 6 and 7.

At Post's mills, near the mouth of Big Rock creek, in the southwestern part of section 34, township 37, range 6, a quarry has been opened in this rock, to a depth of almost five feet. It is here a light buff or yellowish, porous limestone, the more solid portions showing a grayish hue on freshly fractured surfaces. The beds lie apparently level, as no dip in any direction is perceptible at this point. The same beds appear in the bed of Little Rock creek, near the quarry, and have been uncovered at one time, half a mile further up the stream, though not now visible. Fossils were rare at this quarry, and when found were generally ill preserved. A few fragmentary *Murchisonia* and *Pleurotomaria*, only, were obtained.

Above this place, according to Mr. Post, this limestone may be found in the bed of the Fox, as far as the mouth of Rob Roy creek, in the southwestern quarter of section 35, township 37, range 6, and it appears in a ledge, visible at low water, in the left bank of the river, in the southwestern quarter of section 34.

About half a mile below Post's mills, on the right bank of the river, in the northwest quarter of section 3, township 36, range 6, there is another quarry, on the eastern side of a small knoll which rises a few feet above the general surface of the bottom land. In this quarry I observed the beds dipping towards all points of the compass, from north around to south by the east, and, from appearances, it seems probable that if the rock was exposed on the western slope of the knoll, it would be found dipping in that direction also. One or two other similar knolls, or slight elevations, occur within a short distance from this, and in one of them, also, the rock has been quarried and presents similar appearances. The rock is the same as that worked at Post's mills, a porous, yellowish limestone, full of traces of organisms, but affording very few well preserved fossils. Those collected here were mostly imperfect casts of *Illænus*, *Pleurotomaria*, *Murchisonia*, *Subulites*, and one or two small fragments of *Zaphrentis* and *Receptaculites*.

Nearly half a mile further down stream, at Black Hawk's Cave, in the eastern part of section 4, the river cuts through a ledge of this limestone, of which about 16 feet in thickness is here exposed. Black Hawk's Cave is a name given to a natural crevice or a small cave in the rock, which formerly extended back into the ledge for some little distance, but which, with several other similar cavities in this ledge, has now been almost or entirely destroyed by the quarrying of the stone for the construction of a dam across the river at this point. At the northern edge of the exposure, the strata dip down at an angle of five or six degrees. At the other side, on the contrary, the beds break off abruptly. On the right bank of the river, the outcrops continue a few rods further down stream before disappearing entirely. The next appearance of the rock is on the right bank of the river, in the eastern part of section 8, where it is quarried for building purposes. It is here, as in the other localites, a light yellowish, porous limestone, crumbling in some of the uppermost layers, but becoming more solid and better, as a building material, the deeper it is worked. It contains numerous nodules of chert, and casts of fossils, seldom, however, sufficiently perfect to be at once recognizable as to species.

Below this place for some distance the strata of this age are met with and are doubtless tilted up by a small anticlinal, the crest of which has most probably been eroded away. The evidence of this fold is in the existence of an exposure of the underlying St. Peters sandstone on the opposite side of the river in the southeastern quarter of section seventeen, and above the next exposure of the Trenton group, and not by any decided dip of the strata in any direction.

One mile above Milford, on the right bank of the river, is Brodie's quarry, where a thickness of over twelve feet of the rock is exposed, a bluish-gray porous limestone, the lowermost beds the darkest in shade of color. This exposure is on the northeastern slope of still another anticlinal than that one before mentioned, the strata having an inclination of between twelve and fifteen degrees in the direction north 60° east. This is further proved by exposures of St. Peters sandstone along the river bluffs immediately below this point. Immediately above, at the edge of the water, the limestone may be seen for a short distance, the beds becoming less inclined and finally appearing nearly horizontal. Still farther down the river, below this fold, nearly on the north line of section thirty, and between one-fourth and one-half a mile above Milford, on the right hand bank, I observed the following section:

	FEET.	IN.
1. Coarse porous yellowish limestone	3	6
2. Hard silicious rock, resembling quartzite	0	6
3. Light gray or drab argillaceous shales, with thin layers of rock, same as No. 2	2	6
4. Light colored shaly bed	2 to 4	
5. Impure yellowish limestone	3 " 5	

The arrangement of the strata in this exposure is very irregular, and their order is somewhat changed, even within a distance of only a few feet from the point where this section was taken. I am at present inclined to consider these beds, as very near the base of the Trenton, close to the junction with the St. Peters sandstone, and possibly indicating something like beds of passage between the two formations.

The remaining outcrops of this group in this county, are to be found in the southern part of township 35, ranges 7 and 6. The westernmost of these occurs on the land of Mr. J. Bushnell, in the northeast quarter of section 36, township 35, range 6, a little over half a mile south of the village of Lisbon. The rock is exposed in the bed of a small rivulet at two points, about a quarter of a mile apart. The most southern of these exposures, is of a soft, brown, porous, decomposing limestone; in the other, the rock is harder, and contains considerable chert. A fragment of a *Receptaculites*, and one or two other indistinct casts of fossils only, were collected here. The next nearest exposure is at Morris's stone quarry, the southeast quarter of section thirty, township 35, range 7, where the rock appears at the surface of the ground on one of the higher undulations of the prairie, and has been quarried for building purposes to the depth of about six feet. It is an unevenly bedded, porous, yellowish or buff limestone, very similar to that described on the Fox river at Post's mills, and like that, contains very few good fossils. The strata here appeared to be nearly or quite horizontal.

A little more than a mile and a half east of Lisbon village, in the northeast quarter of section 29, the same beds have been again quarried, on the land of Mr. S. Peterson. About half a mile south of this quarry, on the banks of a small run, I noticed many freshly quarried fragments, which had been taken out of its bed, but the strata in place were not visible at the time of my visit. The stone was similar in all respects to that already described, but was altogether richer in organic remains, containing very many epecimens of *Receptaculites*, *Zaphrentis*, *Orthis testudinaria*, and various other fossils. Still farther down the course of the same run, in the northeast corner of section thirty-two, just below the crossing of the county road, I saw low ledges of thin bedded yellow or buff limestone, extending for a few rods in the banks of the stream.

East of these localities, no beds of rock appear above the surface of the prairie, for between two and three miles, though it is evidently not buried very deeply. The nearest exposure in this direction north of the county line, is nearly in the center of the northern part of section thirty-five, on the land of Mr. Lewis Sherrill, who has opened a quarry for building stone at this point The rock is the same as at the localities farther west. Though not perceptible to the eye, the rocks here have a slight dip to the eastward, not more, probably, than twenty or thirty feet in a mile. The most eastern point where the rock appears at the surface, is half a mile east of Mr. Sherrill's, in a small ravine in the northeast quarter of section thirty-five, and the southeast quarter of section twenty-six. Still farther east, it has only been struck in wells.

St. Peters Sandstone.—From observations made in the adjoining parts of LaSalle county, it seems probable that a small area in the western part of township 35, range 6, is underlaid by this formation. The tract thus underlaid is of very inconsiderable extent, at most, probably not more than one or two square miles, and includes portions of sections eighteen, nineteen and thirty, in the western part of the township. The only exposures of this sandstone in the county, are those which have been incidentally mentioned in the remarks on the Trenton group, in the preceding pages, as occurring along the Fox river In the center of the southern part of section 19, township 36, range 6, on the western bank of the river, the principal one of these exposures occurs, the sandstone being brought up by an anticlinal, forming the base of the arch, and is exposed in excavations in the side of the bluff for thirty feet or more above the water. It is here as elsewhere in this part of the State, a soft incoherent mass of white sand, hardly deserving the name of sandstone, so soft, indeed, as to be easily excavated at some points with a common spade. Another exposure of the same material in a similar situation, was observed higher up stream, on the eastern bank in the southern part of section seventeen.

Economical Geology.

Building Stone.—From what has been stated in the preceding pages, it will be seen, that Kendall county is well supplied with building stone, although the finer qualities, suitable for cut stone and ornamental work, are generally wanting. The proximity, however, of the excellent quarries at Batavia and Joliet, will make up for this deficiency. The limestones of the Niagara group, in the northern part of the county, afford a good material for rough walls, foundations, etc., and have been used to some extent for general building purposes, though the beds are not always of sufficient thickness to supply the better qualities. At Mr. Shontz's quarry, in the northwest part of the county, blocks of considerable size are sometimes obtained, but in many instances contain so much chert as to seriously impair their quality. The limestone beds of the Cincinnati group, which have been quarried to some extent along the Fox river, at Oswego and Bristol, and also on the AuSable, in the southeastern part of the county, are found, whenever sufficiently resistant to atmospheric influences, to afford a fine material for foundation walls, and for the rougher kinds of masonry generally. The heavier bedded limestone of the Trenton group, affords a still better material for the same uses, and has also been employed for general building purposes, and found to answer well. It will readily be seen from the descriptions of quarries and outcrops of rock in the preceding pages, that they are so distributed as to be easily accessible from all parts of the county.

Other Building Materials.—Limestone, suitable for the manufacture of a fair article of quick lime, is found in both the Niagara and Trenton groups in this county. At Oswego, lime is made from rock of the former age, which appears here to be somewhat magnesian, and affords a strong, but not perfectly white, lime. The limestones of the Trenton group are burned at Posts's mills, and a little above Milford, on the Fox river, and also near Lisbon, and at each of these places, is said to afford a good article of lime. Another source of this material which has been made use of to a limited extent, is found in the collections of limestone boulders, frequently met with in the deposits of modified Drift along the Fox river.

Sand, for building purposes, is abundant throughout the county, and the subsoils and Drift afford good clay for making the ordinary red brick, which are manufactured in quantities to meet the local demands, at various places in the county. In this connection, I may also mention the white sand of the St. Peters sandstone, occurring along the lower course of Fox river, in this county, which, when free from mineral salts, by which it is sometimes deteriorated, affords one of the very best materials for the manufacture of glass.

Sulphur Springs.—Springs containing sulphuretted hydrogen, occur in several places in township 35, range 8, in the southeastern portion of the county. One of the largest and best known of these springs, occurs on the land of Mr. L. House, a little southwest of the center of section 15. It is a clear, constanspring, and gives off an odor of sulphuretted hydrogen, which is perceptible at several yards distance, although the sulphurous taste to the water is not sufficiently strong to render it disagreeable to most persons; indeed, the reverse is very often the case. It is much favored by picnic parties, and from various relics which have been found in its immediate vicinity, it would seem to have been used as a watering place by the aboriginal inhabitants of the country. Another similar spring, of less value, occurs close to Mr. House's residence, between a quarter and a half a mile farther west, on the western bank of the creek, and still others, in the southern part of section 23, and in the northeastern part of section 16, in the same township. The formation in which these springs appear to have their source, is the Cincinnati Group.

Peat.—Small deposits of peat have been found in the prairie sloughs in various parts of this county, and also at one or two points along the Fox river, but, with only one exception, so far as I am aware, they have not been tested as to their extent or value as fuel. On the western bank of Fox river, in the northeast quarter of section 4, township 36, range 6, there is a bed of this substance, which occupies an area of probably seventy or one hundred acres, or even more, which has been used to some extent in the neighborhood as fuel, and is reported to have made a good fire. This bed will, I think, average six feet or more in depth, over the whole area which it occupies, and is probably the most extensive deposit of the kind in the county.

From the small fragments of stone coal, which are occasionally found in the Drift and surface deposits in this county, some persons have been led to suppose that coal beds might be found under the surface. In regard to this, it can only be said, that there is no probability of the existence of any such beds under any part of the county, excepting, perhaps, a very small area in the extreme southwestern corner. It is possible, indeed, as has been stated before, that small outliers of the Coal Measure strata may yet exist, under the Quaternary deposits in this region, and these might also be productive, but as we have no certain knowledge of their existence, the chances are too hazardous to warrant any expenditure of labor or capital in their search.

CHAPTER X.

MORGAN COUNTY.

Morgan county is bounded, on the north, by Cass county; on the east, by Sangamon county; on the south, by Macoupin and Greene counties; and on the west, by Scott county and the Illinois river. It comprises about fifteen and two-thirds townships, or about five hundred and sixty-three square miles, of which nearly or quite one-half, is well wooded, and the remainder is prairie. Besides the Illinois river, which forms a portion of its western border, this county is watered by several lesser streams, among which, the Indian, Mauvaisterre, Sandy, and Apple creeks, may be mentioned as the most important. Nearly all of these streams head in this county, and attain considerable dimensions before passing beyond its limits.

The country, away from the immediate vicinity of the streams, is, in most parts, a gently undulating prairie, with a rich, dark colored surface soil, similar in all respects to that in the adjoining regions, and differing but little from the general character of all the prairie soils in this portion of the State. On the broken land along the streams, the soil is generally lighter colored and clayey, and generally bears a heavy growth of black, white and red oak, with some laurel oak, pin oak, bitternut and shell-bark hickory, black walnut and butternut, white and slippery elm, ironwood, sassafras, hackberry, red bud, soft and sugar maple, linden, and hazel. On the narrow strip of level bottom land which borders many of the streams, we find, in addition to many of the above species, swamp white oak, chinquapin oak, sycamore, paw-paw, and cottonwood. In the extreme western portion of the county, the Illinois river is bordered by an extensive tract of bottom land, ranging from four to six miles in width at different points. In this bottom, with the exception of a few tracts of low sand ridge, covered with stunted blackjack, the soil is a rich arenaceous loam, which, whenever sufficiently elevated, is one of the best soils in the county. A considerable portion of this bottom, however, is flooded by the Illinois river, and certain tracts are so little elevated as to form permanent shallow lakes or sloughs. Along the edges of the bluffs, at their immediate base, there is generally a sandy slope, similar in soil and timber to the sand-ridges in the bottom, the material of which is derived from the marly sand of the Loess, of which the bluffs are mainly composed.

The Loess, the most recent of the geological formations after the Alluvium, occurs in this county only along the Illinois river bluffs, in which it attains a thickness of from sixty to eighty feet. Back from the bluffs, it rapidly thins out, and is seldom seen extending more than a mile or two up the side ravines, and, indeed, it frequently disappears entirely within a much less distance. The material is generally an ash or buff colored, marly sand, containing fossil fresh water shells of existing species, here as elsewhere, forming high, conical bluffs, which constitute a peculiar feature in the landscape. So resistant is this material to atmospheric influences, that many of the bluffs are crowned by steep, mural escarpments of compacted sand, which preserve their shape from year to year, in spite of the wearing action of the frosts and showers.

The deposits of the Drift extend over nearly the whole surface of the county, their thickness ranging all the way from twenty to eighty, or one hundred feet, and at Jacksonville, its thickness amounts to even one hundred and forty-seven feet. The material of this formation is generally a blue or yellow clay, with occasional seams or strata, of quicksand or gravel. Good sections of this formation are, however, rarely met with, both on account of the infrequency of shafts or wells of sufficient depth, and of the frequent lack of reliable information in regard to those wells which have been sunk. In general, however, the brown clays are uppermost, and are underlaid by bluish clays and hard-pan. A little distance north of Prentice Station, on the St. Louis, Jacksonville and Chicago railroad, in the extreme northeastern part of the county, a shaft passed through eighty-five feet of the beds of the Drift, and the following section was reported :

		FEET.
1.	Surface soil, and brown and yellow clays	25
2.	Bluish hard-pan	50
3.	Sandy clay, containing a log eighteen or twenty inches in diameter	10

Logs and drift-wood are reported to have been frequently found in the clays' etc., of the Drift in this county, but seldom as deep as in this instance, at the very base of the formation.

Boulders are abundant in all parts of the county, but in this region are seldom of such very large size as farther north. Many of the transported boulders show polished and striated surfaces on two or more sides, but no such surfaces were observed in any of the exposures of rock *in situ.*

The older geological formations which appear in the surface exposures of this county, are the Coal Measures, and the St. Louis limestone. Of the former, there is between the uppermost and lowest exposures a considerable aggregate thickness, it is difficult to state exactly how much, but probably several hundred feet, including the horizon of at least three or four workable coal seams. Of the St. Louis limestone, only a limited thickness of the upper beds is exposed.

Coal Measures.—This formation underlies nearly the whole surface of the county, the only portion in which it is not the uppermost rock, being a comparatively limited area along the Illinois bottoms and bluffs. We find considerable difficulty in forming a correct idea of the details of this formation in this county, on account of the wide separation and varying character of the different outcrops. The aggregate thickness, however, may, I think, be safely set down as not less than three hundred feet, and probably still more. Within this thickness there are at least three, and most probably four, beds of coal of sufficient thickness to be profitably worked.

The only surface outcrops of No. 1, of the Illinois river section, are along the Illinois river bluffs, near the northern line of the county, in sections 2, 3 and 4, township 16, range 12 west of the 3d principal meridian, where it has been worked to a slight extent, by drifts driven horizontally into the hillside, and it has, besides, been worked at least at one point by stripping along the outcrop.

The following section, which is made up, in part, from natural exposures in the northeastern quarter of section 3, and in part from information derived from the parties who had worked the coal, will serve to furnish an idea of the order and thicknesses of the beds at this point:

		FEET.	IN.
1.	Clay shale, containing a few indeterminate, apparently vegetable, impressions, and passing downwards into the underlying bed	1	5
2.	Arenaceous shale, containing no fossils except, perhaps, a few crinoidal stems	3	
3.	Brownish sandstone, containing a few indistinct vegetable impressions	20	
4.	Black slate	2	
5.	Drab, argillaceous shale (exposed)	5	
6.	" " " (reported)	2	
7.	Coal	2	6
8.	Fire clay, penetrated only a few inches.		

The sandstone No. 3, of this section, has been worked to some extent as a building stone, and is exposed in several places along the river bluffs in this vicinity. The other beds are only to be seen at one or two points, and the outcrop of the coal vein itself is everywhere covered up by soil and debris from the beds above.

In the southwest quarter of section 4, township 16, range 11, it is reported that a coal bed occurs a few feet below the bed of Indian creek, which has been worked by stripping, during seasons of very low water. A little distance below the point where the coal was said to occur, I observed masses of nodular, argillaceous limestone, which I judged to have been derived from the under-clay of the coal. Still farther up the creek, in the northeast part of section 15, I observed an outcrop of a reddish, concretionary sandstone, which may perhaps be the equivalent of the sandstone No. 3, in the above section.

McPherson's coal bank is situated in the northwest quarter of section 33, township 16, range 12. The distance from the surface of the ground to the bottom of the coal in the shaft, is about twenty-six feet. After passing through fifteen feet of soil and drift clay, about eight feet of dark colored shale and black slate, containing many heavy ironstone concretions are met with, and still under this, the coal—at this point only twenty inches in thickness. The fragments of black slate, which had been thrown out of the shaft, contained a few fossils, among which I recognized only *Discina nitida*, the others being mostly unrecognizable.

A bed of coal, which may possibly be the same as that in the localities already mentioned, is reported to occur in about the center of the western part of section 20, township 16, range 12, on the land of Mr. Harris. The coal is said to occur at a depth of about twelve feet below the bed of Coon run, where it has been struck by excavations, although it was found impossible to work it on account of the water. The bed of the creek, a short distance above this point, is composed of rather irregularly bedded, light-gray limestone; the beds, as far as I was able to observe them at the time of my visit, lying horizontal, or very nearly so. Below, along the banks and bed of the stream, in the eastern part of section 19, there appears a light colored, shaly limestone in the bed of the stream, and about two hundred yards still farther down stream, but higher in actual position, heavy beds of a soft, massive, ferruginous sandstone appear in the sides of the ravine. I am, however, inclined at present to think that these beds may possibly belong to the upper part of the St. Louis Group, and not to the Coal Measures, though the lack of fossils and the want of continuity in the exposures, make this a rather difficult question to decide with certainty.

The coal No. 2, of the Illinois river section, is worked in this county, at one of its typical localities, and probably at several other points also. At Neelyville, on the Toledo, Wabash and Western railroad, near the western border of the county, this seam of coal immediately underlies the Drift, at a depth below the surface, at the principal diggings, of from ten to fifteen feet. A shaft sunk upon the top of the hill, however, a short distance south of the railroad, passed through eighty-five feet of the brown and blue clays of the Drift, before reaching the coal. The seam varies from four feet two inches to four and one-half feet in thickness, of which, however, only about three and one-half feet is available—from eight inches to one foot of the coal being required to be left to support the roof.

In the eastern part of the village, a shaly sandstone, varying in color from light reddish to gray, is exposed in the bottom and sides of the ditches along the railroad, for a distance of three hundred yards or more. The whole thickness exposed is not over eight feet, and the beds appear to be very nearly horizontal. From the locality and appearance of this sandstone or sandy shale, I am inclined to consider it above the coal in stratigraphical position. If otherwise, its presence here must be due to a fault, of which we have no other evidence.

Other localities, of probably this same vein of coal, are in the northwest corner of section 34, township 16, range 12, and in the southern part of sections 21 and 22 of the same township. The former of these localities is on the land formerly owned by Mr. Robert McPherson, and the coal is said to have been worked by drifting into the side of a small ravine. The bed was reported to be about four feet in thickness. No satisfactory information as to the overlying beds could be obtained. This coal bank is distant about half or three-quarters of a mile from McPherson's shaft, already noticed as a locality of the lowest seam, No. 1, of the Illinois river section. Its level is probably from forty to fifty feet above the coal seam opened by the shaft. In the southeastern quarter of the same section, I observed exposures of arenaceous shales and shaly sandstone, which I judged to be the overlying beds of this coal, and at one or two points the exposures were from ten to fifteen feet in vertical thickness.

In the southern part of section 22, the workings were scattered along the bank of Coon run, for a distance of about half a mile. The coal was worked by horizontal drifts, in the side of the bluff, all of which have been long disused, and few particulars as to the vein itself, or its surroundings, could be obtained. It was reported to be three feet or more in thickness. A short distance below the coal diggings, limestone is reported to occur in the bed of the stream, but this was not visible at the time of my visit. It is possible that the coal in this locality may be No. 1, although from the position of the diggings, I had thought it more probably No. 2.

In the northwest corner of section 18, township 15, range 11, at the point where the Toledo, Wabash and Western railroad crosses the *Mauvais-terre*, there is an exposure on the side of the bluff, and in the railroad cutting, of thirty feet or more of shaly sandstone and arenaceous shales. The shaly beds may be traced along the stream for a distance of between a quarter and a half a mile from the bridge, where they finally disappear, and above this point along the stream, and indeed in the whole northeastern portion of the county, there are no prominent exposures of any of the beds of the older formations.

On Willow Branch, in the southeast quarter of section 19, township 15, range 11, I observed the following section, in a small quarry near the road-crossing:

		FEET.
1.	Shale, slightly argillaceous at top, and passing downwards into a shaly sandstone, containing concretions with indistinct vegetable impressions	6
2.	Massive, brownish-white sandstone, containing a few imperfectly preserved impressions of plants	12
3.	Clay shale, only exposed at one or two points in the lower bed of the quarry...6 or 7 inches.	

No. 2 of this section is the bed which is here worked as a building stone. It is extremely soft and easily worked when first taken out, but is said to harden on exposure to the weather. It is considerably used for general building purposes in the vicinity. Below the quarry, exposures of shaly sandstone and arenaceous shales occur along the banks of the creek, wherever it touches the bluffs which edge the narrow bottom, as far as the county line, a distance of about one mile, and probably continue to appear along the lower course of the branch in Scott county. Above the quarry, there are no prominent outcrops, although the same beds undoubtedly occur in the hill sides. At one point only, in a ravine running down to the creek, in the northeast part of section 29, I observed indications of the sandstone in the material thrown out of an artificial excavation.

Passing southward from this point, along the western side of the county, the next exposure of the Coal Measures is on the south side of Sandy creek, in the western part of section 16, township 14, range 11, on the land of Mr. S. Cannon. The outcrop is only of limited extent, and consists of light colored, rather argillaceous shale, overlaid by sandstone. The vertical thickness of the shale is altogether, perhaps, four feet. The sandstone was only seen in tumbling masses, with, at one point, a glimpse of the rock in place. No fossils were collected in this locality.

Proceeding up the ravine of Sandy creek, in the bottom of one of the side ravines opening from the northward, in the northwest quarter of section 11, township 14, range 11, I observed a large, tumbling mass of light colored, brittle limestone, which evidently had not been far removed from its original bed. Similar masses occur in one or two of the side ravines of this stream and its tributaries in this vicinity, but no good outcrop of beds in place occur along this part of its course. In the western half of section 9, township 14, range 10, there are exposures of light colored, fossiliferous limestone, which has been quarried in several places on the bluffs on the south side of the creek. Underneath this limestone, at one or two points, a little west of the center of the section, appear exposures of a light colored shale, apparently entirely destitute of fossil remains. The whole exposed thickness of the shale is about ten feet; that of the limestone is not so easily ascertained, as the exposures are not continuous, and the whole thickness is not exposed at any one place. Judging, however, from the difference of level in the different exposures, it would seem to be not less than that of the shale, and probably much more.

A little farther up stream, near the center of the section, at the crossing of the railroad (St. Louis, Jacksonville and Chicago), a shaft has been sunk about half way up the side of the bluff. It penetrates the Drift and underlying beds, to the depth of about eighty feet, and afforded the following section, according to the statement of parties present during the excavation:

		FEET.	IN.
1.	Surface soil and drift clay	22	
2.	Light colored shale	52	
3.	Limestone, containing *Hemipronites crassus*, *Petalodus destructor*, and a few other fossils	0	10
4.	Black slate, containing *Aviculopecten rectalaterarea*, *Cardinia*, and impressions of plants	1	6
5.	Coal	3	
6.	Fire clay	8	8
7	Buff or yellowish, close-grained limestone, breaking with a slightly conchoidal fracture	8	

No. 2 of this section, is probably the shale which has been mentioned as outcropping along the stream below this point.

No prominent exposures of rock occur on any of the tributaries of Sandy creek, lying to the southward. The nearest point where they appear, is on the left bank of Coal creek, in the northwest corner of section 16, township 14, range 10, where a foot or two in thickness, of a light colored calcareous shale, or shaly limestone, has been laid bare by the wash of the stream, in the overhanging bank. The same occurs at several points below, along the stream, and at one place in the northwestern part of section 29, I obtained a few fossils, *Spirifer cameratus*, *Athyris subtilita*, *Chonetes mesoloba*, *Productus longispinus*, etc. A little farther down stream, near the center of the south part of section 30, is Fuller's coal bank, at which locality I took the following section:

		FEET.
1.	Light grayish limestone, containing a few fossils, mostly the same as those mentioned above	15
2.	Argillaceous shale	2
3.	Coal No. 3?	4
4.	Fire clay passing downwards into nodular argillaceous limestone	5
5.	Argillaceous and arenaceous shales	4
6.	Clay, containing nodules of bituminous limestone, exposed	4

This section was made up along a line of exposure of more than one hundred yards in length, and the thickness of the different beds are an average, and not exact measurements taken at one point only. The coal ranges in thickness from three feet eight inches to four feet, and is overlaid at one or two points with decomposing black slate. Perhaps this is generally the case, but the exposures do not show it well. The limestone No. 1 is well exposed, and the vein of coal has been slightly worked by stripping in one of the side ravines a little distance below the main coal banks, and the limestone here affords the same fossils as were mentioned before, together with many large *Productus punctatus*, *P. scabriculus*.

Following down the stream, below the coal bank, we find a reddish, shaly sandstone exposed in its bed, which, at a point about a mile below, forms a perpendicular bank ten feet high. Similar exposures of the same light reddish or brown sandstone, occur here and there along the creek to the county line, and below, into Greene county.

In the village of Murrayville, and its immediate vicinity, two or three borings have been made, in two of which coal is reported to have been met at depths of one hundred and seven, and one hundred and twenty feet. This coal was reported as overlaid by sandstone and black slate; but in neither case did the boring penetrate the coal more than twenty-three inches. It may, possibly, be the same vein as that which is worked on Coal creek, and which I have referred with doubt, to No. 3, of the general section, or possibly, another higher vein; the known facts are, however, not sufficient to decide the question with certainty.

The principal natural exposures of the Coal Measures in this county, which remain to be mentioned, are those on the main Apple creek and its principal tributaries. The greater portion of the eastern and northeastern townships of Morgan county, are upland prairie, where all the older formations are deeply buried under the heavy accumulations of Drift, and where none of the streams, which here take their rise, have cut down through these Quaternary deposits to any considerable extent.

In the northeast quarter of section 18, township 13, range 8, on the north fork of Apple creek, I observed an exposure in the side of the bluff, of about twenty-five feet in vertical hight, the upper twenty feet of which is an arenaceous shale, and the remaining lower portion consists of one or two thin beds of limestone, with black carbonaceous shale, and fire clay, and in some places, one or two inches of coal between the dark colored shale and the fire clay. The limestone afforded a few fossils, chiefly of one or two species of *Bellerophon* and *Cyathoxonia*. These lower beds may be traced along the banks of the creek for about half a mile, although the exposure is not continuous, and then, the dip of the strata being, apparently, a little greater than the fall of the stream, and in the same direction (about southwest), it finally disappears beneath its bed. A little below where these beds disappear, I observed in one of the side ravines running down from the northward, heavy exposures of a massive brownish or reddish sandstone, having, probably, a total thickness of over thirty feet. A similar sandstone is said to occur some two miles above this point on the creek, but it escaped my observation while examining this region. This sandstone contained a few impressions of plants, generally very imperfectly preserved, but no other fossils were obtained.

Continuing down the ravine of the creek about half a mile further, I observed a place where there had, apparently, been limestone quarried, though the ledges were not visible at the time of my visit. From the appearance of the fragments, I judged it to be an irregularly bedded, light grayish, fossiliferous rock, somewhat resembling the limestone outcropping along Sandy creek, which has been described on a preceding page. Below this exposure, outcroppings of the older rocks are not frequent along this fork of Apple creek, until we approach its junction with the main creek. About half a mile above the junction, in the northeast corner of section 34, township 13, range 9, I observed a foot or two in thickness of argillaceous shale, with about eight inches of impure shaly limestone appearing in the bank of the creek, just above the water. Below the forks of the creek, as far as to the county line, a bed of hard, bluish limestone appears at the water's edge, and at a few points it may be seen that this is overlaid by argillaceous shales. Passing up a small branch, which comes down from the northwestward, and enters the creek bottoms near the county line, I observed at one point, in the northwest quarter of section 34, on the land of a Mr. Hart, a place where a coal seam had been worked by stripping, though I was unable to see the coal itself, or to note its surroundings. A little farther up the ravine, I observed exposures of a shale with thin beds of limestone, and over all, a massive grayish sandstone and sandy shale. Passing up the east fork of Apple creek, above the junction, we find the continuation of the exposures of the hard, bluish limestone before mentioned, appearing along the banks of the stream for a mile or more, sometimes in place, and sometimes in large tumbling masses in the bed of the creek. It also appears in some of the side ravines, and has been somewhat quarried at one place on the land of Mr. Benj. Taylor, in the southwest quarter of section 31, township 13, range 8, at a distance of half or three-quarters of a mile from the creek. About a quarter of a mile above the Sperry bridge, in the northwest quarter of section 31, township 13, range 8, a section made up from about one hundred yards' exposure along the banks, was as follows:

		FT.	IN.	FT.	IN.
1.	Limestone	2			
2.	Bluish and dark colored argillaceous shales	12			
3.	Black slate	2			
4.	Coal	1	3 to	1	6
5.	Clay, containing calcareous nodules	6		“	8
6.	Shale. Only visible in the bed of the stream.				

No fossils were obtained from any of the strata, except the limestone, which afforded a few imperfectly preserved specimens of *Productus punctatus*, *P. semirecticulatus*, and *Athyris subtilita*. This limestone is probably the same as that observed farther down stream, as it is identical with it in appearance and thickness. Still farther up stream, it appears still higher in the side of the bluffs, and has been considerably quarried, and a little above this point it disappears entirely, and is seen no more along the stream.

Up a small branch which enters Apple creek from the southwest, near the center of the south line of section 27, I observed outcrops of shale, limestone, etc., with a small vein of coal, in the following order.:

		FEET.
1.	Light colored, fossiliferous limestone	1
2.	Clay shale	3
3.	Black or dark colored shale or slate	10
4.	Light colored shale	8
5.	Coal	1
6.	Fire clay, exposed	4

In one or two places, I observed an exposure of a few inches of shale in position above No. 1 of this section, but not in contact. The fossils in the limestones were generally imperfect and indistinct. In the shales below they are easily obtained, and tolerably well preserved. The most abundant species observed, were corals of the genus *Cyathoxonia*, *Leda ventricosa*, *Astartella varica*, *Pleurotomaria*, *Grayvillensis?* an *Orthoceras*, etc. A little below the point at which the foregoing section was taken, there is a continuous ledge of the shale, from five to eight feet in hight, extending along the bank of the river for a distance of twenty or thirty rods. Still farther up the ravine, in the northeast quarter of section 34, the coal again outcrops, and still above this, near the Macoupin county line, in the southwest quarter of section 35, there is an exposure of ten or fifteen feet of shale, overlying the thin limestone, No. 1, of the above section.

North of these exposures, in the eastern part of the county, there are but one or two points where the older rocks appear above the surface, or are artificially exposed. One of these occurs on the land of Mr. John Rohrer, in the northeast quarter of section 25, township 13, range 8, where a reddish sandstone, in layers varying from two inches to a foot in thickness, has been quarried as a building stone. The stone occurs in the bed of a small branch, running north into Apple creek, and four or five feet of gravel has to be removed before reaching the valuable portions of the rock. To the northward of this, in the vicinity of Waverly, sandstone is said to have been met with in digging wells, at a depth of sixteen or eighteen feet—possibly the same beds that are exposed at this point.

Near Prentice station, on the St. Louis, Jacksonville and Chicago railroad, in the northeast corner of the county, a shaft has been sunk in the beds of the Coal Measures, and the overlying Drift, to the depth of about two hundred and twenty feet, and has been continued by boring over one hundred feet more. As this affords the only means we have of judging of the Coal Measures in this part of the county, it will, perhaps, be as well to give the section of the beds passed through, in full, as reported to me. After eighty-five feet of Drift, the variations of which have been already given in a previous portion of this chapter, the order of the strata was as follows:

		FEET.	IN.
1.	Rotten black slate	2	6
2.	Coal	0	2
3.	Fire clay	12	4
4.	Shale	1	
5.	Coal	0	2
6.	Fire clay	1	8
7.	Sandstone and shale	16	7
8.	Shale with bands of ironstone	56	
9.	Black slate (fossiliferous)	3	10
10.	Soft sandstone	15	
11.	Shale	14	
12.	Limestone	1	
13.	Slate	2	
14.	Coal	2	10
15.	Fire clay	6	

Ninety-two feet below the lowest coal in this section, another two inch seam of coal was reported by the borers, the intervening strata below the fire clay, being argillaceous limestone six feet, and eighty feet of shale. If the lower coal in the shaft is No. 4 of the Illinois river section, as given by Prof. Worthen, as seems quite probable, it would indicate a remarkable thinning out of all the coal seams in this particular region, and a considerable local variation in all the strata at this point.

The only point which remains to be mentioned, in Morgan county, as a locality where the beds of the Coal Measures have been penetrated, is at the city of Jacksonville, where a bed of coal, thirty inches in thickness, is reported to have been struck by a boring made on the grounds of the Insane Asylum, at the depth of one hundred and ninety feet. Another boring, which was made near the track of the Toledo, Wabash and Western railroad, just without the eastern city limits, is reported to have struck coal at very nearly the same depth, but with the remarkable thickness, according to a journal of the boring, which was kindly furnished by the proprietors, Messrs. Davenport & Berry, of eighteen feet. This, it seems probable, is a mistake, but the shaft which was being sunk at this place, at the time of my visit (Nov. 30th, 1868), had not penetrated the Drift, which here is over one hundred and forty feet in thickness, and no more reliable data could be obtained.*

---

*Since this report was made, a section of the Jacksonville shaft has been obtained from Messrs. Davenport & Berry, and is as follows:

	FEET.	IN.
Drift clay and gravel	142	
Quicksand	10	
Hard, green sand, with a trace of coal	2	
Soapstone (clay shale)	14	
Sandstone	3	9

St. Louis Limestone.—The outcrops of this formation are confined to the base of the bluffs, along the eastern edge of the Illinois bottoms in this county. In lithological characters, it is also rather variable, consisting of reddish and light colored sandstones, and a hard, impure, reddish, calcareous rock, which appears in one or two places. It nowhere presents such a development as may be met with farther south, and disappears entirely before reaching the northern limits of the county. The most northern exposure observed, was in the southwest corner of section 19, township 16, range 12, on the land of Mr. Chamberlain, where I observed a light gray limestone on the sides of the bluff road, and a little higher up on the side of the bluff, large, tumbling masses of a light colored sandstone. About a quarter of a mile below this point, ledges of a reddish, splintering, calcareous sand rock, appear in the side of the bluffs, and have been somewhat quarried.

Passing still further to the south and west, along the bluff road, we see at various points, a light reddish, shaly sandstone, appearing in the ditches alongside of the road, and in the bottoms of some of the small ravines, which come down through the bluffs. Mention has already been made, in the earlier part of this chapter, of a reddish sandstone occurring in heavy ledges up in the ravines of Coon run, which may, possibly, belong to this formation, but more probably to the Coal Measures. About half a mile north of the southern line of the county, in the western part of section 36, there is a small quarry on the edge of the bottom, in a rather coarser grained, light colored sandstone, which has been excavated to the depth of about four feet. In none of the exposures of the rocks of this age in Morgan county, were any good fossils obtained, but ledges of rock containing some of the characteristic fossils of this group in tolerable abundance, occur a short distance over the boundary in Scott county.

	FEET.	IN.
Gray, sandy shale	12	
Clay shale with iron bands	6	
Conglomerate	2	6
Gray shale	14	
Limestone	0	6
Black shale with concretions of septaria	4	
Coal	3	
Fire clay, not passed through	1	6

The fire clay passes downward into a very hard, arenaceous rock, filled with Stigmaria. The slaty, black shale of the roof contains *Lingula umbonata*, *Discina nitida*, *Aviculopecten rectalaterarea*, and *Monotis? gregaria*. The concretions of septaria are veined with selenite. From the appearance of the coal and the beds with which it is associated, I am inclined to regard it as probably the equivalent of coal No. 3 of the section in Fulton county. A. H. W.

Economical Geology.

Coal.—As will be seen by the foregoing pages, at least four or five different beds of coal appear in the surface outcrops and artificial excavations of this county, several of which have been more or less extensively mined. In fact, the whole surface of the county, excepting the Illinois bottoms, and a small area immediately adjoining, is probably underlaid by one or more veins of coal. The lowest of these, the No. 1, or Exeter coal, has been mined to some extent along the river bluffs, near the northern border of the county, where the seam is about two and a half feet thick. It is, also, probably, the seam that is worked at McPherson's, and on Indian creek in section 4, township 16, range 11, but beyond these points I have not identified it in any exposures within the limits of the county. Although the coal of this seam is of a good quality, yet it is not generally of sufficient thickness to be profitably mined, except along the natural outcrops, or where it is only of comparatively insignificant depth below the surface.

The next seam above this, the Neelyville coal, is rather extensively worked at that place. The seam here is about four feet thick, and only twelve or fourteen feet below the surface at the principal diggings along the railroad. As, however, it has no good natural roof, but is overlaid immediately by the clays of the Drift, from six to twelve inches of coal has to be left for a roof, and much trouble and expense must be incurred in cribbing. The coal is of good quality, and is much used on the Toledo, Wabash and Western railway, and is also sent elsewhere to market.

The four-foot vein, which outcrops along Coal creek, in section 30, township 13, range 10, and which I have referred, with doubt, to No. 3 of the general section, has been mined to some extent, but the works have been abandoned. This bed contains some pyrites, disseminated throughout the mass, but when sufficiently free from this material, the coal is reported to be of a very good quality.

The other veins of coal which are worked at all in this county, probably belong to the middle and upper Coal Measures, and as far as they have been opened, are generally of comparatively slight thickness. It would seem probable, however, considering these beds to belong to the upper or middle parts of the formation, that other and heavier seams of coal may be met with at greater depths beneath the surface. All the borings which have been made in the central part of the county seem to confirm this, as far as they go. The small vein outcropping along Apple creek, in the southeastern part of the county, is not easy to place in the general section. It probably is, also, in the middle portion of the series, if not higher. The thickness is too slight to admit of its being profitably worked, except by stripping, etc., along its outcrop.

Clays.—Some of the underclays of the different coal seams in this county, will probably furnish a good material for fire brick, tile, or pottery. The clay beds under the different coal seams, however, generally appear at the surface only along the sides of high bluffs, or in the bottoms of deep ravines, and have not been as yet, turned to economical account. Good clays for ordinary brick making, are found in the beds of the Drift, under the surface soils in all parts of the county.

Building Materials.—The sandstone over coal No. 1, in the northwestern part of this county, has been worked to some extent as a building stone, and in some instances, appears to answer the purpose well, and when a proper selection is made of this material, it appears durable. The stone abutments of a bridge over Indian creek, at Arenzville, just over the line in Cass county, which were built for the proposed Rock Island and St. Louis railroad, are of this sandstone, quarried within the limits of Morgan county, and after ten years' exposure, appear as whole and sharply cut as when first laid. In some parts of these beds, however, the rock seems to crumble on weathering, and should, therefore be rejected as a building stone.

The sandstone worked on Willow Branch, in section 19, township 15, range 11, is probably near the same geological horizon. It is very similar in appearance, being a light brown or gray sandstone, weathering, however, to a rather lighter color than that from the previously mentioned localities. It is, as has been said before, quite soft and easily worked when first quarried, but is said to harden on exposure.

The limestone beds of the Coal Measures, and their use as a building material, have been briefly noticed in the preceding pages. Their use has been mainly local and limited, and from the restricted nature of the exposures in the sides of high bluffs or bottoms of ravines, and the general inconsiderable thickness of the strata, it seems probable that it could not well be otherwise. The sandstone beds of the Coal Measures, when sufficiently resistant to atmospheric influences, are likely to afford the principal home supply of building material in this county. The sandstones, etc., of the St. Louis group, which outcrop in this county, have also been used to some extent, but no such quarries as are found in this group in the adjoining counties, have as yet been opened in Morgan county.

Some of the limestone beds in this county, appear suitable for the manufacture of quick lime. Most of this article, however, is derived elsewhere, and I am not aware that this manufacture has been carried on to any extent in any place in the county. Sand and gravel for building purposes are sufficiently abundant in all parts.

CHAPTER XI.

CASS AND MENARD COUNTIES.

The two counties of Cass and Menard, which are described in this chapter, are situated contiguous to each other in the western central portion of the State. Cass county, the largest of the two, is bounded on the north by Mason county, on the east by Menard county, on the south by Morgan county, and on the west by the Illinois river. The remaining boundaries of Menard county are Mason and Logan counties on the north and east, and Sangamon county on the south. The superficial area of Cass county is about four hundred and sixty square miles, of Menard county about three hundred and eleven, thus forming an aggregate area for the whole district of about seven hundred and seventy-one square miles, or very nearly twenty-one and a-half townships.

The surface of the country is, for the most part, gently undulating, becoming hilly and broken only along the courses of the streams. In the western part of Cass county, along the Illinois river, there is a strip of bottom land, varying in width from three and one-half to five miles. This extends also along the Sangamon river on the northern border, and through the eastern part of this district, gradually, however, becoming more narrow and interrupted until, through the greater part of Menard county, the bottoms are seldom more than half a mile broad.

The soil of the prairie portion of these counties is the same as that in the whole of this portion of the State, a dark colored loam, with a lighter colored clay sub-soil. On the ridges and bluffs which skirt the streams, we find this sub-soil everywhere, except upon the Loess formation, exposed at the surface of the ground, and generally bearing a heavy growth of timber. On the bottom lands, the soil is an alluvial arenaceous loam, and, excepting in localities where the sand too greatly predominates, is an excellent and productive soil. The principal kinds of timber upon the uplands are, the common varieties of oak and hickory, with elm, sugar-maple, black and white walnut, linden and various other species which are rather less frequent. On the bottoms we find willow, ash, sycamore, cottonwood, etc., in addition to some of the before mentioned species, forming a considerable proportion of the timber. The proportion of prairie to wooded land in the whole district is probably nearly two to one.

The geological formations in this district, consist of the Quaternary deposits, the Loess and Drift, and the Coal Measures, which alone of the older formations, underlie the surface beds of clay, gravel, etc., in these counties. The Loess forms the bluffs along the Illinois and Sangamon bottoms, in Cass county, and also appears in the bluffs of the Sangamon river, and Salt creek, to some extent, in Menard county, though it does not appear as prominently in the landscape as farther west. Its general features here are the same as in the other river counties, and it forms the same bald bluffs, that are seen in other localities along the Illinois and Mississippi rivers. The material here is an ash or buff colored marly sand, containing fossil fresh water shells of existing species. The thickness of the formation is considerable, some sixty or seventy feet immediately at the bluffs, but it rapidly thins out in the back country, in many places disappearing entirely within a very short distance. It appears to extend the farthest inland along the Sangamon river in Cass county, north of the town of Virginia, and several good sections of this deposit may be seen in the cuts on the Peoria, Pekin and Jacksonville railroad, between that place and Chandlerville. Along the upper course of the Sangamon, in Menard county, this formation is scarcely to be seen at any point, and may perhaps be said to cease entirely along this stream, within the limits of the county.

The Drift deposits in this district consist of brown, yellow, and blue clays, with boulders, while sand and gravel seams are of frequent occurrence amid the mass. The thickness will probably range, over the whole district, between forty and one hundred feet; of this, only an estimate can be made in most cases, as shafts and wells of sufficient depth, and other opportunities of obtaining any exact knowledge in regard to this particular, are rarely met with over a greater portion of this region. At Sweet-water, in Menard county, it was found to be one hundred and ten feet from the surface to the uppermost bed of rock, and the boring presented the following section.

	FEET.
1. Surface soil and brown clay	40
2. Quicksand	11
3. Blue clay	59

In the eastern part of section 2, township 17, range 6, near the village of Athens, a shaft commenced at the bottom of a ravine, which cuts down some forty or fifty feet below the general level of the country, was sunk eighty-six feet without striking a bed of rock, and at the depth of sixty-five feet, pieces of coniferous wood, in a tolerable state of preservation were taken out. Many large boulders, which had to be removed by blasting, were also met with, some of them of granite, indicating by their material a remote northern origin, but more were fragments of the underlying Coal Measure limestone, and sandstone, containing many of their characteristic fossils and showing, by their comparatively angular outlines, and unworn surfaces, evidences that they have not been transported far from their original beds. Some of these latter, near the mouth of the shaft, are of such size and in such positions, as to appear like a natural outcrop of the Coal Measure rocks, and might perhaps be taken for such, were it not for the incontestible proof to the contrary afforded by the rocks themselves. Throughout the western portion of this district, good sections of this formation are rarely met with, and accurate information as to its details cannot be obtained. Its thickness, however, may be put down approximately, as at least averaging sixty or seventy feet, over the greater part of this region.

Coal Measures.—This formation, as developed in this district, comprises a thickness of over three hundred feet of the middle and lower portion of the series, and contains two or three seams of coal of workable thickness. The best development appears to be to the eastward, the westernmost exposures being also the lowest in stratigraphical position, and the higher beds appearing as we travel east. The principal exposures, commencing with the lowest, are as follows:

In the southwest part of section 21, township 18, range 11, where the road between Virginia and Beardstown comes down through the bluffs to the bottom lands along the Illinois river, there are several old coal shafts, only one of which, (Mr. Kinney's,) is now worked. This is reported to have afforded the following section:

	FEET.
1. Soil, (Loess.)	15
2. Brownish sandstone, containing many vegetable impressions	13
3. Limestones, ("Blue rock.")	2
4. Clay Shale, ("Soapstone.")	12
5. Coal, (No. 1 of Illinois river section.)	3
6. Fire clay, very hard	4

No. 2 of this section crops out along the bluff road, at the edge of the bluffs, and a few rods farther west, in ledges several feet in vertical exposure. It is a soft micaceous sandstone, of a light brown, or whitish-brown color, and appears slightly crumbling at this locality. About a quarter of a mile farther north, the coal seam, No. 4, is reported to have been reached by digging in at the foot of the bluff, and worked by stripping. Still farther to the northward, in the northwest quarter of the same section, I noticed in an old quarry on the side of the bluff, a little to the right of the wagon road, an exposure of about ten feet in thickness of a heavy bedded sandstone, the same as that which is met with in the shaft, and exposed on the roadside near by. A little farther northeast, near the eastern line of section sixteen, the coal seam is said to appear again, and to have been worked to a slight extent in the side of a ravine about half a mile from the road.

Above the north line of section 21, the bluffs, for about two miles, are mostly of Loess, and it is necessary to go up the side ravines in order to see the exposures of rock. About half a mile up the large ravine, which cuts through the bluffs in the southern part of section 10, I observed on the eastern side, another exposure of the sandstone, (No. 2 of the section) and a little above this, near the northwest corner of section 14, I also noticed about ten feet exposed of the shales No. 4, capped by a single layer of limestone, two feet thick, (No. 3). The coal seam must be very near the bottom of the ravine at this point, but it is not exposed. The outcrops of the sandstone continue up this ravine and its branches, in the eastern part of section 14, and the western part of section 15, for about three-quarters of a mile above this point, and then disappear entirely. The rock is, in most respects, the same as in the localities before described, a soft, even textured sandstone, varying in color from brownish red to a dirty white, and in some portions having a light bluish tinge, and a slightly variegated appearance. It contains a great abundance of fossil vegetable remains, Calamites, etc., but from the nature of the rock, very few are found in a good state of preservation.

From the mouth of this ravine, for a short distance to the northeast, along the face of the bluffs, there are no very good exposures of any of the beds. There seems to be here, however, a low anticlinal. The strata having gradually risen, until at this point, the coal seam No. 4, has been worked by drifting into the side of the bluff almost midway between the base and summit. The crown of the arch is very near this point, and the direction of the axis of the fold must be, judging from appearances, about southeast. The vein of coal is said to be about three feet thick at this point, but at present only the entrances to the old drifts, and the debris can be seen, no work having been done here for a number of years.

A short distance further along the bluff road, nearly on the line between sections 10 and 11, another large ravine opens out, and the rock again appears. The coal seam was formerly worked also at this point, at a level some fifteen or twenty feet above the road, though its outcrop is not now visible. Just below the level of the old drift, I observed an outcrop of what appeared to be a nodular argillaceous limestone, which I take to be just underlying the fire clay. Above the opening of the drift, the shale No. 4, appears, and still higher up the bank, the limestone No. 3, has been slightly quarried, and above all the sandstone, No. 2 appears, but at present the debris of the sandstone and shale covers all the lines of junction, and no very reliable measurements of the thickness of the beds can be taken. The sandstone continues to appear in the sides of the ravine, and in the bed of the small stream which occupies it, for upwards of half a mile. Its total thickness, although in no place so fully exposed as to afford an opportunity for accurate measurement, can hardly be less than fifty or sixty feet.

East of the mouth of this ravine, through the northern half of section 11, this sandstone appears in ledges in the bluffs, at an elevation of fifty feet or more above the road, and has been quarried in one or two small ravines. In one of these ravines, in the northeast quarter of section eleven, I observed the only outcrop I was enabled to find of the coal seam, the exposed thickness of which was about three feet. This is on the northeastern slope of the anticlinal, and only a little further on the Loess and Alluvium come down to the road, and the exposures of rock cease to appear for the distance of several miles. Leaving the last mentioned localities, and continuing eastward along the base of the bluffs, the next prominent exposure is met with near the center of the western part of section 10, township 18, range 10, on the left bank of Job creek, just above the point where it comes out of the bluffs and enters the bottoms. Here, the sandstone No. 2 has been quarried in the hill-side, some thirty feet or more above the water, and presents precisely the same appearance as at the other localities already mentioned. The lower beds of limestone and shale, and the coal seams, if, indeed, they occur above the bottom of the ravine at all, are completely hidden by the fragments and debris from above. The sandstone appears again at one or two points farther east, within the distance of one mile, in the northeast quarter of section 10, and almost on the line between sections 10 and 11.

The only remaining locality in Cass county, where the older rocks appear at the surface, or are artificially exposed, is on Panther creek, near Chandlerville, in sections 5 and 6, township 18, range 9. A shallow coal shaft in the southeast quarter of section 6 afforded the following section, according to Mr. William Shores, the proprietor:

		FEET.	IN.
1.	Surface soil	4	
2.	Gravel ("Blue bind")	4	
3.	Black slate	2	
4.	Clay shale ("Soapstone")	13	
5.	Coal	2	6
6.	Fire-clay, passing downwards into nodular limestone	2	
7.	Clay, penetrated	2	

The shale and slate appear in the bank of the creek, for upwards of half a mile above the coal diggings, seldom rising more than two or three feet above the water's edge. No fossils were discovered. It seems quite probable that this seam of coal is the same as that in the exposures further west, although from the lack of continuity in the exposures, and of other sufficient evidence, it may, perhaps, be best to refer it only provisionally.

In Menard county, the eastern portion of this district, we find exposed only the middle beds of the Coal Measures, no rocks lower than the under clays of the coal No. 4 of the Illinois General Section having been identified. The following section shows the order of superposition and comparative thickness of the different beds in this region:

	FEET.
1. Limestone	20 to 30
2. Argillaceous shales	10 " 15
3. Coal (No. 7, Ill. R. sect.)	1½
4. Fire clay and shales	18 " 20
5. Limestone	3 " 4
6. Coal (No. 6, Ill. R. sect.)	1 in. to 3
7. Fire clay	5 " 10
8. Shales and sandstone	30 " 40
9. Limestone	1 " 3
10. Black slate	1 " 4
11. Coal (No. 4, Ill. R. sect.)	5 " 7
12. Fire clay	6 " 8

Of this section, the beds below the coal No. 6, have not been identified in any natural outcrop, and have only been reached by borings, and shafts sunk down to the coal No. 4, which is extensively worked at Petersburg and vicinity. The upper and middle beds of coal in the above section, were also formerly worked in the vicinity, but since the opening of the lower vein the work has been discontinued, or is only carried on in a desultory way by stripping. The fire clay under these two beds was not separated from the shale in all the sections reported to me by other persons, and it is possible that in some cases it may not be developed to any considerable extent.

Just above the village of Petersburg, on the western bank of the Sangamon river, and close to the water's edge, the limestone overlying the middle vein of coal No. 6 appears, and has been quarried to a slight extent. It is a rather close textured, light drab or gray limestone, weathering buff, and contains a few fossils of the species *Spirifer cameratus*, *Athyris subtilita*, *Athyris Roissii*, *Productus costatus*, *Productus longispinus*, etc. The underlying coal has been worked by stripping, a few rods further down stream, and is, at this point, two or three feet thick. The peculiarity of this seam of coal is its uneven thickness, it being reported sometimes to vary, within short distances, from a thickness of two or three feet to only as many inches, or even less; and, from this fact, it is generally considered too unreliable to be worked, except by stripping along its surface outcrops. Both the coal and its limestone roof are passed through by Taylor's and Wright's coal shafts, which are sunk from the top of the bank to the lower coal, or No. 4, within a quarter of a mile of this outcrop.

On the opposite side of the river, near the center of the north line of section 25, township 18, range 7, and about a mile and a half above the town, there appears a ledge of brownish sandstone, which extends along the river bank about two hundred yards, with an elevation above the water of some six or eight feet. This appears to replace the limestone over the middle coal, as it is stated that that vein immediately underlies it, and was at one time worked at this point. The rock appeared massive, or very irregularly bedded at this point, and seemed to stand exposure well.

The upper bed of coal is not at present worked, but the entrance to the old drifts may be seen in several places along the Sangamon river bluffs, above Petersburg. It does not outcrop near the village, but its position may be told by these marks, and the clay shale which forms its roof appears at one or two points up the ravine which opens out of the bluffs just above the woolen mills on the southern outskirts of the town, and may be seen on close examination at the mouths of some of the drifts. This shale is also exposed in other side ravines farther up the stream, but the beds underlying the coal, and between it and the middle seam, are only exposed at the Salem mills, some two miles above Petersburg, on the west bank of the river. At this place, just below the mill-dam, at the edge of the water, there is an outcrop of the middle coal, overlaid by two feet or more of shaly, bluish limestone, and still above this, there is exposed, in the almost perpendicular bank, nine or ten feet of light colored shales, containing a few thin seams of clay and bands of iron ore. A little farther up the road, and about ten feet higher in actual elevation, the upper coal seam crops out of the bank on the roadside. It is here about sixteen inches in thickness, and this is said to be pretty constantly the same in all places where it has been worked. The thickness of the middle bed could not be well ascertained by personal observation at the time of my visit, but it was stated to me to be two or three feet.

Following up the road south of the mills, the entrances to the disused drifts along the bluffs at the side of the road, will show the position of the small seam, though there are no good natural outcrops for some little distance. About half a mile up this road, however, in the northwestern corner of section 36, township 18, range 7, we find it again outcropping in the bed of a dry branch, and a little farther up, the bottom and sides of the branch are composed of the drab and brown, and in some parts nearly black, argillaceous shales, which form its roof. This shale contains many concretions of ironstone, generally lenticular in form, and sometimes of considerable size. Still farther up the ravine, at Arnold's quarry, we find, above the shale, though the line of junction is nowhere visible, heavy beds of a light gray or bluish-gray limestone, exposed in the hill sides to the hight of some thirty feet or more above the bed of the branch. This limestone is quarried, both as a building stone and for the manufacture of lime, and affords many fossils of the species *Spirifer lineatus*, *Spirifer cameratus*, *Athyris subtilita*, *Retzia mormoni*, *Rynchonella Osagensis*, *Productus longis-*

pinus, and others. The exposures of both this limestone and the underlying shales, are not such as to allow any very exact estimate of their respective thicknesses. The limestone, however, will probably not exceed twenty or thirty feet, and the shale fifteen or twenty feet in total thickness.

On the Sangamon river above the Salem mills, there are no very good exposures above high water mark, though beds of rock are said to form the bottom of the stream at one or two points. A coal shaft, however, which was sunk on the land of Mr. Sampson, in the southeast quarter of section 32, township 18, range 6, affords a section of all the beds, from the top of the upper seam of coal to the under clay of the lower and largest bed. The total depth of the shaft is a little over ninety feet, and the strata were passed through in the following order, as reported to me:

		FEET.	IN.
1.	Surface soil and blue clay	14	
2.	Black slate or shale	1	
3.	Coal	1	3
4.	Fire clay and shale	17	3
5.	Hard limestone	4	
6.	Coal	2	6
7.	Fire clay and shale (very hard)	39	
8.	Black slate	1	
9.	Coal	6	4
10.	Fire clay, penetrated in sump	5	

It will be observed that, in this section the limestone, which generally is found just above the roof slate of the lower coal, is missing. This, however, is probably only a local peculiarity.

Another point along the bluffs of the Sangamon, where rock is said to occur, is in the northwestern part of section 15, township 17, range 6, on the land of Mr. A. Hale, where it is stated that limestone was quarried out in former times. I visited the excavation, but the rock was not visible above the rubbish, and judging from the chips, I made out the rock to be the same in appearance and fossils as that in Arnold's quarry, near Salem. The only doubt is, whether this may not have been merely a large detached mass, imbedded in Drift, like many in this vicinity.

In the northeast quarter of section 19, township 18, range 5, on the headwaters of Indian creek, there appears in the banks and beds of the stream, for about two hundred yards, a bed of light colored, nearly white, limestone, which seems to be almost entirely made up of crinoidal stems, no other fossils being observed. Half a mile or more below this, on the land of Mr. T. Kincaid, in the northeast quarter of section 24, township 18, range 6, the limestone again appears, and has been quarried to the depth of about seven feet. It is here somewhat different, the upper five feet in the quarry being of a grayish, heavily-bedded limestone, containing very few fossils. A section of the quarry would be nearly as follows:

		FEET.	IN.
1.	Heavy bedded, gray limestone	5	
2.	Dark colored, somewhat shaly beds	1	6
3.	Dark colored, argillaceous shale, containing *Hemipronites crassus*, etc		6
4.	Hard, pyritous band, with a trace of coal		1½
5.	Whitish fire clay, only penetrated		8

Numbers 4 and 5 of this section, are not to be seen in this quarry without special excavation, and numbers 1 and 2 appear to graduate into each other at some points.

Below this for about a quarter of a mile, the limestone is met with by digging into the banks, and outcrops at one point in the side of the branch, about one hundred and fifty yards below the quarry. The rock there is somewhat different from that before described, being a very light colored, nearly white, thinly and irregularly bedded limestone, containing *Spirifer lineatus*, *Athyris subtilita*, and a few other species, in considerable abundance.

The remaining exposures in the southern part of Menard county occurs in the southern parts of sections 13, 14 and 15, township 17, range 7, along the banks of Rock creek. The easternmost of these, occurs in the southeast corner of section 13, a little west of the Springfield road, where a thickness of a few feet of light colored shale appears in a field on the bank of the creek. About three-fourths of a mile above this on the stream, and nearly due west, we came to the first of the limestone quarries, which continue to appear at intervals for upwards of a mile above this along the creek. The stone which is quarried here is a gray or bluish-gray fossiliferous limestone, occurring in rather heavy beds in the bed of the creek, and in the sides of the bluffs along its course. In one or two places I noticed from one to two or three feet of brownish shaly sandstone immediately above, and resting upon the limestone. It seems to me probable that this limestone may be identical with that at Arnold's quarry, near Salem, and in that case it will probably be found to underlie the Drift deposits over a considerable area in the southern part of Menard county. Its thickness at this point could not be well ascertained, as at no one point is there exposed more than a few feet, but from the difference of level of the different outcrops and workings, the beds being apparently horizontal or nearly so, I should judge that it is not less here than at Arnold's, at least twenty feet, and perhaps more.

North of Petersburg, in Menard county, there are comparatively few outcrops, or artificial exposures, borings, etc. At the eastern extremity of the wagon bridge over the Sangamon, near the brewery, there is a slight exposure of shales, and the small upper (16 inch) vein of coal has been somewhat worked in former times, and in the hill side a little distance to the north of this point, I observed many large boulders or fragments of Coal Measure limestone, which may perhaps indicate the presence in the body of the bluff, of the heavy limestone beds which occur above this coal, farther to the south.

Fischer's coal mine is situated on the railroad nearly two miles north of the village of Petersburg, and nearly at the base of the river bluffs. The following is the section afforded by the main shaft:

	FEET.	IN.
1. Surface soil and Drift clay	46	
2. Shale	14	
3. Hard, dark colored limestone		4
4. Black slate	2	
5. Coal No. 4	6	
6. Fire clay and shale	8	

The hard limestone, No. 3 of this section, lies very irregularly upon the dark slate, its average thickness, however, is in this shaft not more than stated above. *Discina nitida*, and one or two other of the species most common in the roof slate of the coal occur also in this limestone, though less abundantly. A shaft which was sunk by Captain Taylor, near the railroad station, about three-quarters of a mile farther south, passed through the same beds, but as this shaft commences higher up on the hill side, some thirty-five feet of the shale was penetrated, and the limestone and slate were rather better developed. The coal No. 6, would doubtless be met with in a shaft sunk from the top of the hill, and perhaps the small upper vein also.

On the eastern bank of the Sangamon, in the center of the eastern part of section 1, township 18, range 7, and about half a mile above the railroad bridge, I observed an exposure of a reddish-brown, shaly sandstone, extending about two hundred yards along the river bank, and rising to a hight of seven or eight feet above low water mark. The rock is precisely similar in appearance to that in a similar exposure on the river bank above Petersburg, which has been described on a preceding page, and which was then said to overlie the coal No. 6. If it is identical with that, it will show a dip of at least twenty or thirty feet to the northward, between Fischer's and this place, a distance of rather less than a mile. A similar sandstone is said to have been quarried in former times, by the early settlers, in the northwest quarter of section 36, township 19, range 7, on the edge of the river bottom at the base of the bluffs. At present no rock in place is visible, but the scattered fragments, or quarry chips are identical in appearance with the rock in section 1, township 18.

The boring at Sweet-water, penetrated to the depth of one hundred and seventy-five feet. After one hundred and ten feet of Drift and surface deposits, the order and thickness of the different beds was reported as follows:

	FEET.
1. Hard limestone	2
2. Pipe clay	10
3. Shale, ("Soapstone."	40
4. Limestone	3
5. Black slate	5
6. Coal	5
7. Fire clay, not penetrated more than a few inches.	

The coal in this section is doubtless No. 4 of the general section, which will probably be found to underlie the greater part of the northern portion of Menard county. No. 6 had probably dwindled in thickness until it was not detected in the boring, as its proper place would be between 1 and 2 of the above section. This boring affords almost the only means of ascertaining with any degree of accuracy the lay of the strata in the more northern parts of Menard county. There remain only two or three isolated localities where the beds of the older rocks have been met with in artificial excavations, and in these instances, the facts necessary to enable one to form a correct judgment are wanting. Near the center of the south line of section 12, township 19, range 7, a bed of yellowish sandstone is said to have been once uncovered in the side of the river bluffs. This is immediately overlaid by a silicious conglomerate, which I am not disposed to consider older than the Drift, and the sandstone may very possibly be of the same age. Near the base of the bluffs, not far from this point, I heard it reported that a small sixteen-inch vein of coal had once been found, but is not now visible. Other localities where coal is stated to have been found are, at the foot of the bluffs of the Sangamon, near the center of section 3, township 19, range 7, and on Clary's creek, near the center of the south line of section 27, township 19, range 8. In neither of these localities were the beds visible, nor could any very satisfactory information be obtained.

Economical Geology.

Coal.—As has been stated in the foregoing pages, all parts of this district appear to be underlaid by the Coal Measures, which here include the horizon of four or five different seams of coal. It seems highly probable, indeed, that there is no portion of the district, excepting the bottom lands along the Illinois and Sangamon rivers, in the western part, that is not underlaid by at least one coal bed of workable thickness. The lowest of these seams, which is exposed or worked anywhere in this region is probably the coal No. 1 of the general section of the State, identical with the Exeter coal of Scott county, although it is possible that it may prove to be No. 2 of the general section, or the same as the Neelyville coal, in Morgan county. The absence of black slate in the roof, and the great thickness of the sandstone above are facts which seem to slightly favor this view, but are, however, not conclusive. The absence of exposures in the southwestern portion of Cass county, is to be regretted as not affording the means of positively determining this question.

This vein of coal is now actively worked at only one or two points in Cass county, although it was formerly much more extensively mined along its outcrop on the side of the bluffs of the Illinois and Sangamon rivers. The seam will average three feet in thickness, and is reported to be of fair quality, the discontinuance of the most of the mining operations, was mainly due to the small local demand, and the competition of other mines in the adjoining counties on the Illinois river.

In the eastern portion of this district, the lowest seam worked is No. 4 of the general section, which will average in the different shafts and borings from five to seven feet in thickness. Along the Sangamon river bottoms, at Petersburg and above, it has been met with at depths varying from seventy to eighty feet. On the upland portions of the county, it has been reached but once, by a boring at the depth of one hundred and seventy feet. This bed has everywhere a good roof of limestone and black slate, and is generally easy to work, although an occasional annoyance is met with in the shape of horse-backs, etc. The coal is pretty uniformly of a good quality for fuel and steam purposes, although the quality of some portions of the vein is sometimes injured for blacksmith's use by the presence of small quantities of sulphuret of iron. This is the only seam of coal which is extensively worked at the present time.

The next seam above this is No. 6 of the general section, which outcrops at several points along the Sangamon river, in the vicinity of Petersburg, and is also met with in one or two of the shafts at that place. A peculiarity of this bed, which has prevented its having been worked to any extent, except along its outcrop, is the tendency it has to run out, it ranging in thickness, within short distances, from three feet to hardly as many inches. It is a softer and less open burning coal than No. 4, and is therefore sometimes preferred to it for blacksmith's use.

Iron Ore.—Mention has been made in the preceding pages of the concretions of the carbonate of iron, which occur rather abundantly in the shales overlying the small upper seam of coal near Petersburg. These, however, hardly seemed to occur in any one place in sufficient abundance to continually supply an iron furnace and render their reduction profitable.

Building Stone.—Probably the best material for building stone in this district is the massively bedded, light gray limestone of the Coal Measures, which is quarried on Rock creek, in the southern part of Menard county, and near Salem, about two and one-half miles south of Petersburg. This may be obtained in blocks of any convenient size, and appears to dress easily and weather well. It has, however, been used chiefly for the rougher kinds of masonry only, the limestone from the Joliet quarries, in the northern part of the State, being generally preferred for the finer kinds of work, such as window caps and sills, etc:, wherever it is accessible. I have seen this limestone used as dressed stone in only one or two instances, but it then appeared to answer well. The limestone quarried on the upper portion of Indian creek, is also said to answer well for foundations and rough walls.

In the western part of this district, a material which seems to promise well as a building stone, is the brownish sandstone, which occurs in very heavy beds above the roof shales of Coal No. 2. This sandstone is usually of a reddish brown color, though in some places it approaches a dirty white, or has a bluish tinge, is very soft and easily dressed when first quarried out, but is said to harden on exposure. At the junction of this rock and the underlying shales, there is generally from one to three feet in thickness of limestone, which has been also quarried to some extent at one or two points. The quantity of this sandstone is such, that it is practically inexhaustible; it is, probable, however, that all parts of it will not be found to answer equally well as a building stone.

Other Building Materials.—Limestones suitable for the manufacture of a fine article of quick-lime, are found in several places in the eastern part of this district, each of the localities already noticed as affording limestone as a building stone, also furnishes a material for the manufacture of lime. Some selection, however, has to be made among the beds at some points, for a material which will afford an article of lime suitable to supply the local needs.

Clay and sand for brick making are found in abundance in all parts of the district, and will, probably, at some future time, become one of the chief sources of building materials in those parts most distant from available stone quarries.

The general surface configuration and soils have been noticed in the first part of this chapter, and but little more need be said. The soil of the upland prairies in this district takes rank with the best in this portion of the State, in general agricultural value. The soil of the timbered portions is also productive when properly cultivated. Along the Illinois and Sangamon rivers, in the bottom lands, there are occasional sandy tracts or ridges, generally covered with a growth of stunted oak and black-jack, which are, of course, inferior, but as a general thing the soil of these bottoms is a deep rich arenaceous loam, which, when sufficiently elevated or properly drained, is one of the most productive soils in the State.

CHAPTER XII.

TAZEWELL, McLEAN, LOGAN AND MASON COUNTIES.

These four counties, which I describe together in the present chapter, are situated contiguously to each other in the central part of the State, and together, comprise a very irregularly shaped area, of nearly three thousand square miles. The respective areas and boundaries of the several counties, are as follows:

Tazewell county comprises an area of about six hundred and thirty-five square miles, and is bounded, on the north, by Woodford county, on the east, by McLean county; on the south, by Logan and Mason counties; and on the west, by the Illinois river. McLean county contains an area of a little more than thirty-two townships, or about eleven hundred and sixty-one square miles, and is bounded, on the north, by Woodford and Livingston counties; on the east, by Ford and Champaign counties; on the south, by Piatt, DeWitt, and Logan counties; and by Tazewell county on the west. Logan county lies immediately south of Tazewell and McLean counties; on the east, it is bounded by DeWitt and Macon counties; on the south, by Sangamon county; and on the west, by Mason and Menard counties. It comprises an area of a little more than seventeen townships, or about six hundred and eighteen square miles. Mason county lies south of Tazewell, and east of Logan county; its remaining boundaries are Cass and Menard counties on the south, and the Illinois river on the west; its area is abont five hundred and eighteen square miles.

The surface of the country over the greater portion of this district, including McLean, Logan, the greater part of Tazewell, and the eastern part of Mason county, is a high, undulating prairie, with here and there groves and belts of timber. The soil is generally a rich brown mold, varying somewhat in different localities, in the proportion of clay, etc., which it contains, some portions being more argillaceous than others. In the timber, however, which occupies scarcely more than one-fifth or one-sixth of the entire surface, and in the broken country along some of the principal streams, the soil is of a somewhat different character, the lighter colored and more argillaceous subsoil appearing at or nearer to the surface.

In the greater part of Mason county, and over considerable tracts in the southwestern part of Tazewell county, the surface configuration varies from that which we have just described; the prairies are low and comparatively flat, and in many portions, were originally overflowed, or marshy, at some seasons of the year. The soil of these prairies is a rich alluvium, generally more or less arenaceous, which forms, when sufficiently elevated or drained, one of the best producing soils in this district. Along the Illinois and Sangamon rivers in this region, we find in some places rather extensive sandy tracts of river formation, and on the Sangamon river, in Mason county, and on the Illinois river, in Mason and Tazewell counties, the bald bluffs of the Loess, are in some localities conspicuous features in the general landscape.

The principal streams occurring in this district, besides the Illinois and Sangamon rivers, which form a portion of its borders, are the Mackinaw river, in Tazewell, Mason and McLean counties, Salt creek, in Mason and Logan counties, and Kickapoo and Sugar creek in Logan and McLean counties. These, with many minor streams, and nameless tributaries, drain nearly the whole surface of this district. With the exception of the Illinois and Sangamon rivers, none of the streams have very extensive adjoining tracts of bottom land, and even along these rivers, the bottoms are frequently of inconsiderable width, or wanting altogether.

The principal kinds of timber found in the upland wooded tracts of this district are nearly the same as those already enumerated as occurring in the adjoining counties, namely, the principal varieties of oak and hickory, black walnut, butternut, maple, bass-wood, red-bud, sassafras, etc. On the river bottoms, and in low damp lands generally, the sycamore, buckeye, black ash, elm, etc., are abundant. The sandy ridges are generally covered with a growth of scrubby oak and black-jack, with a thin admixture of other species.

The geological formations appearing at the surface in this district, consist almost entirely of the Drift and later formations, the older rocks outcropping only at a comparatively few localities, in Tazewell and Logan counties. The underlying rock, however, as far as can be ascertained from these outcrops, as well as from artificial exposures by shafts, etc., in various parts of the district, consists entirely of the different beds of the Coal Measure series.

The Loess, the uppermost of the more recent geological formations, appears only in the vicinity of the Illinois and Sangamon rivers, and consists here as elsewhere, of buff or ash colored marly sand, containing fresh water shells of existing species. It is not everywhere equally well developed, and in various localities along the Illinois river, in Mason and Tazewell counties, it either does not appear or is not at all conspicuous. It may be well seen, however, along the Sangamon river, in Mason county, where it appears in the bald, rounded bluffs, with occasional mural-appearing escarpments covering their summits, which form so characteristic a feature in the landscape along the river below. In the northern part of Tazewell county, although this buff marly sand appears to some extent in the bluffs along the Illinois river, it is not by any means as well exposed, or prominent, as in the counties farther to the south.

The Drift formation, which covers the older rocks in almost every part of this district, is here composed of beds of blue and brown clay, sand, and gravel, and varies in thickness, in different portions, from fifty feet in the western part of Tazewell county, to two hundred and fifty feet in the Bloomington shafts. It has been penetrated, however, at comparatively but few points, and over the greater portion of this region, its depth can only be approximately estimated. It seems probable, indeed, that it may be of this thickness over considerable portions of McLean county, as a boring at Chatsworth, in the adjoing portion of Livingston county, was reported to have penetrated to a depth of two hundred and fifty feet before striking rock.

The material of the Drift in this region, appears to be generally roughly stratified, alternating beds of sand, gravel, and clay, are frequently met with in wells and borings. The sand and gravel beds, generally make up but a very small part of the total thickness, though sometimes single beds attain a very considerable thickness, as, for instance, at Chenoa, in the northern part of McLean county, where a boring for coal passed through a bed of sand and gravel thirty feet in thickness, overlaid by forty-five feet of the usual clays of this formation. Occasionally, also, a bed of black earth or vegetable mould, still containing pieces of wood, trunks of trees, leaves, etc., only partially decayed, is met with, and a bed of quicksand, containing fossil land or fresh water shells of existing species. The following section of the Drift, afforded by a shaft sunk in the city of Bloomington, is of especial interest as showing both of these conditions at unusual depths. The shaft was sunk by the Bloomington Coal Mining company, near the track of the Chicago and St. Louis railroad, about half a mile north of the depot:

		FEET.
1.	Surface soil, and brown clay	10
2.	Blue clay	40
3.	"Gravelly hard pan"	60
4.	Black mould, with pieces of wood, etc	13
5.	Hard-pan and clay	89
6.	Black mould, etc	6
8.	Blue clay	34
8.	Quicksand, buff and drab in color, and containing fossil shells	2
9.	Clay shale, (Coal Measures.)	
	Total	254

Another shaft, a little over a mile distant from this one, passed through materially the same succession of strata, with only local variations in the thickness of the different beds. The quicksand, No. 8 of the above section, resembles somewhat in appearance the sands of the Loess, and the only species of the contained shells which could be identified was the *Helicina occulta*, which is also not uncommon in the Loess of the river valleys in this State. Beds of black vegetable mould are met with at less depths than in this section in various places in this district, as for instance in the vicinity of Pekin, Tazewell county, where it is said, in a few instances, to have tainted the wells which penetrated to it to such an extent as to almost render the water unfit for use.

Sections of the Drift are also afforded by the borings for coal, which have been made in various parts of this district. In all cases they show variations of the material from blue to yellow clay, sand and gravel, but do not generally afford sections of such especial interest as the shafts at Bloomington, nor is the depth of the formation as great. At Chenoa, its thickness was found to be ninety feet from the surface to the rock, at Lexington one hundred and eighty feet, at Atlanta one hundred and twenty-six feet, at Lincoln seventy feet, at Cheney's Grove one hundred and two feet, and at several points in Tazewell county from sixty to one hundred feet or more. Its thickness is quite irregular, but seems, however, to be greatest in the central and eastern portions of the district. In Mason county, we have no very reliable data upon which to base our estimates, but its average thickness in that portion, I think, may be safely put down at not less than fifty feet, and is probably much more.

In the western part of Tazewell county, in the ravines and broken country along the Illinois river, I observed, in a number of places at the base of the Drift, a bed of cemented gravel or conglomerate, showing sometimes an irregular stratification, similar to that of beach deposits. A ledge of this material, nine or ten feet in thickness, may be seen in the northwestern quarter of section 7, township 25, range 4 west of the third principal meridian, up one of the side ravines which comes down through the Illinois river bluffs, a little south of Wesley City, in Tazewell county, and other similar ledges appear in various places in the vicinity of Fond du Lac, and also on the Mackinaw, in the eastern portion of the county. Another similar bed of cemented gravel, of, however, a comparatively insignificant thickness, may be seen about half way up the face of the bluff, at the steamboat landing in the city of Pekin, where it does not appear to be more than a few inches thick. I have not observed any similar deposits in the eastern portion of the district, either in Logan or McLean counties, nor have I heard of its having been met with in sinking the various shafts or borings.

Coal Measures.—All the stratified rocks which outcrop within the limits of this district, belong, as has been already stated, to the Coal Measures, and the actual surface exposures are confined, for the most part, to a thickness of about sixty or eighty feet of the middle portion of the formation. In the whole district, there is but one boring which affords an artificial section of the beds down to the base of this formation. This one is that made by Voris & Co., on the bottom lands on the Tazewell county side of the Illinois river, and directly opposite the city of Peoria. The first bed of the Coal Measures which is met with in the boring, is about forty feet below the lower coal seam which is worked in this section, No. 4 of the Illinois river section, as given by Prof. Worthen. The following is a section of the first four hundred and fifty-nine feet of the boring. Below that depth, the records kept by Messrs. Voris & Co. were not complete, as to the thickness and material of all the different beds:

		FEET.	FEET.
1.	Alluvial soil of river bottom	4	
2.	Sand	4	
3.	Gravel (boulder drift)	20	
4.	Clay shale	59	
5.	Bituminous slate	3	
6.	Fire clay	15	
7.	Clay shale	15	
		—	120
8.	Coal	4	
9.	Clay shale	34	
10.	Sandy and argill. shale (very hard)	34	
11.	Sandstone	4	
12.	Nodular, argill. limestone	6	
13.	Compact, fine grained sandstone	5	
14.	Hard, dark blue, sandy shale	25	
15.	Coal	3	
		—	235
16.	Sandy and argill. shale	25	
17.	Bituminous shale, with thin bands of limestone	57	
18.	"Cherty rock"	44	
19.	Hard, silicious rock, mainly chert—possibly chert and limestone intermixed	33	
20.	Fine grained sandstone	65	
		—	459

As nearly as the limits of the formations can be made out from this section, I think that at least that portion between the base of the Alluvium and Drift, and the bituminous shale and limestone No. 17 of the section, may be referred to the Coal Measures. The remainder is Devonian, with perhaps some of the upper beds Lower Carboniferous. The exact equivalents of the two beds of coal passed through, may perhaps not be stated with certainty; the lower one, however, is probably No. 1 of the Illinois river section. The greatest depth reached in the boring was seven hundred and seventy-four feet, and the lowest rock was a gray, porous limestone, the fragments of which, brought up by the instruments, were exactly similar in appearance to some of the upper limestones of the Niagara group, exposed in the northern part of the State, with which formation this bed may doubtless be properly identified.

The coal seam which is worked in this immediate neighborhood, is No. 4, as has been already stated. A good exposure of this coal may be seen near the track of the Toledo, Peoria and Warsaw railroad, at the point of the bluff where the road enters the valley of Farm creek. It is here immediately overlaid by the Loess and Drift, and is about four feet in thickness, the same as its average in other localities thereabouts. It is worked in various places, both in the river bluffs and for a mile or more up the valley of Farm creek, by horizontal drifts into the hill sides, some of which, in their various branches, are of considerable linear extent. The beds overlying the coal are not exposed at the surface at any point north of Farm creek, but the seam is generally found to have a roof of sandstone or sandy shale in the interior portions of the drifts. South of the creek, however, this sandstone is exposed in many places up the side ravines, and in R. A. McClelland & Co.'s shaft, in the center of the southern part of section 34, township 26, range 4, it was found to be twenty-eight feet in thickness between the coal and the overlying drift clay and gravel. This, however, is by no means to be taken as its full average thickness, as at this point it has probably lost much of the upper portion of the bed by denudation.

Passing up a small branch, which comes down through the bluffs from the southward, just back of the village of Fond du Lac about half a mile, I observed a striking exposure of about twenty-five feet in vertical thickness of concretionary sandstone, sandy shales, and soft argillaceous sand-rock, which belong to these same sandy strata overlying the lower bed of coal. The more shaly beds contained numerous iron-stone concretions, and I observed in the more massive portions, what appeared to be indistinct vegetable impressions, but no other fossils. About half a mile or a little more, still farther up the ravine, the upper vein of coal has been worked to a very slight extent. In actual position, it must be, at this point, at least seventy feet above the coal No. 4, and is possibly still more than that. It is here reported to be about three feet in thickness, and is overlaid by about two feet of grayish, fossiliferous limestone, with occasionally an intermediate layer of black slate just over the coal, and forming its roof. Still another seam of coal about fifteen inches in thickness, is said to outcrop farther up the hollow, but after a careful search I was unable to discover its outcrop, and concluded that it must have been covered by the sliding of the drift gravel, etc., from the bluffs above.

Along the Illinois river bluffs, between Fond du Lac and Wesley City, there are several points where coal is now, or has been worked, and there are a few exposures of the overlying sandstones, in the bluffs near the main wagon road. South of Wesley City, there are scarcely any exposures on the river face of the bluffs, but up the side ravines they are more numerous. In one of these ravines some distance from the road, on the land of Mr. Davis, I observed the following succession of beds in a vertical exposure, for about sixty rods along the side of the bluffs:

		FEET.	IN.
1.	Shale passing downwards into black slate	25	
2.	Coal	1	6
3.	Fire clay, passing downwards into nodular limestone	11 to 12	
4.	Limestone	3	
5.	Sandstone, exposed for only a few inches.		

It seems to me probable, that the vein of coal observed here, is still above both of the coal seams which are worked in this region; the distance between this and the next vein below it, I should not judge to be more than forty or fifty feet. The limestone which almost always overlies the coal No. 6, is entirely wanting here, although, as may be seen by the section, a bed of limestone occurs below its under clay, and farther down the creek. Below the exposures from which the above section was made up, numerous thin beds of limestone are to be seen, intercalated in sandstone outcrops. These limestone bands appeared to be somewhat fossiliferous, but no good specimens were obtained.

In the northeastern part of section 24, township 25, range 5, on a northern fork of Lick creek, I noticed a small quarry in a ledge of soft, light gray and brown micaceous sandstone, generally thin bedded and shaly, but in some places with the beds thick enough to answer for building purposes. The total vertical thickness of the exposure was less than twelve feet. Passing farther down the branch, in a general westerly and southerly direction, we find the hill-sides along its banks strown thickly with fragments of similar sandstone, indicating the probable existence of the same beds, but a short distance under the soil. At a point on the immediate bank of the creek, near the center of the section, I observed an exposure of about twenty feet of sandy and argillaceous shales, containing a thin seam of coaly matter, not over one or two inches thick at its best development, and from that down to nothing. About half a mile further east, near the center of the eastern line of the section, alongside of the road which crosses the creek at this place, and well up the bluffs, I observed the outcrop of a coal seam, which had been worked to some slight extent, and which I take to be the upper workable vein of this region, No. 6 of the Illinois river section. The whole exposure at this point, presented the following section:

		FEET.
1.	Shale	9
2.	Limestone (light colored)	2
3.	Dark colored shaly beds, in some portions approaching black slate in appearance and texture	2
4.	Bluish shaly clay	1
5.	Coal	3

Farther to the eastward from this point, and higher in the bluffs, I observed limited exposures of a reddish, shaly sandstone, or arenaceous shale, which seems, from its position, to overlie the uppermost beds of the above section.

In the vicinity of Pekin, there are but few natural exposures of the underlying rocks, but the lower coal is mined at several points in the neighborhood of the city. The coal is generally overlaid by black slate, with, as is stated, in some cases a foot or two of limestone. Above the slate there is generally from twenty to forty or fifty feet of sandstone or sandy shales, according to the locality of the shafts on the edge of the bluffs, or farther up towards the rolling upland. This sandstone may be seen in the bottoms of ditches at one or two points along the Tremont road, about a mile east of the city of Pekin, and in the immediate vicinity of the principal coal mines.

At Mr. Hawley's place, about five miles southeast of Pekin, a shaft was sunk, which passed through both the upper and lower coals, affording a section of the intermediate beds, which, as reported to me, was as follows:

		FEET.
1.	Argillaceous shale	4
2.	Light colored limestone	2
3.	Coal	4
4.	Fire clay	8
5.	Sandstone	50
6.	Bluish black slate	4
7.	Coal	4
8.	Fire clay	8

About two miles east of Mr. Hawley's place, in the southwest quarter of section 20, township 24, range 4, on a branch called Lost creek, there is said to be another exposure of brownish sandstone, of very limited extent. I failed to find this locality myself, but if a sandstone occurs here, it may be that overlying the lower coal, or possibly a still higher bed, not represented in the above section.

In the central and eastern portions of Tazewell county, there are a few localities where borings, etc., have been made, but satisfactory records of the variation in the strata could not in all cases be obtained. At Rapp's mills, near the center of the north line of section 20, township 24, range 4, a shaft was sunk to the depth of eighty-five feet, and, as it was reported to me, struck limestone at that depth. If this be the case, it was very possibly the limestone overlying the upper coal, but, without more reliable data, it is impossible to speak with certainty. The shaft was abandoned before completion, on account of the difficulty of keeping it free from water. At Delevan, in the southeastern portion of the county, a boring was made, which was reported to have passed through sixty feet of sandstone, and, below that, seventy-five feet more of arenaceous and argillaceous shales. No coal was reported in this boring.

In Mason county there are no natural exposures of the older rocks, and, as far as I could ascertain, no good artificial sections are afforded in shafts, wells, borings, etc. Passing eastward, however, into Logan county, we find along Salt creek, some distance above Middletown, a few tumbling masses of bluish limestone, which have evidently come out of the bluffs, but no good exposures. In the southeast quarter of section 13, township 19, range 4, a boring was made in the side of the bluff, by Messrs. Boyd, Paisley & Co., of Lincoln, which passed through one hundred and thirty feet of alternating beds of limestone, and arenaceous, and argillaceous shales, passing through the Drift and surface deposits at the depth of only fifteen feet. A seam of coal was also stated to have been met with near the bottom of the boring, but its thickness could not be satisfactorily ascertained. I also heard it stated that a seam of coal about two feet in thickness, had been worked by the early settlers of the county in this vicinity, and afterwards abandoned on account of its poor quality. No traces of the outcrop, or the old workings, are now visible, and I am not able to state with any degree of exactness, the place in the series of this seam of coal, though it is undoubtedly among the upper beds of the Coal Measures.

At Rankin's mill, about two miles farther up stream, in the northwest quarter of section 7, township 19, range 3, the creek flows over a bed of limetone, which is also quarried at one or two places on the southern bank. The rock is a light gray, or bluish-gray, irregular bedded limestone, and contains a few of the common Coal Measure fossils, of which *Spirifer cameratus*, *S. lineatus*, *Athyris subtilita*, and a few others only were collected. Its thickness here, as ascertained by means of a well dug in one of the quarries, was eleven feet; and underneath it was found four feet of black slate, underlaid by seventeen feet of fire clay, and then six feet of limestone. The hole was continued by boring to a depth of eighty feet from the surface, at which depth a seam of coal was struck, the thickness of which I was unable to ascertain. This, or a similar bed of limestone, outcrops on Lake Fork of Salt creek, in section 23, township 19, range 8, in a ledge about three feet high, which has been quarried to a slight extent at one point, near the center of the section.

The above comprises all the natural exposures within the limits of the district. There remain, however, various shafts, borings, etc., which, over the larger portion of the territory, afford us the only means whatever of ascertaining the character and thickness of the underlying beds. Of these, with one or two exceptions only, the shafts alone furnish sufficiently reliable sections of the strata, and as yet but two or three have been sunk. At Lincoln, the shaft

---

NOTE.—Since this report was written, the shaft at Lincoln has been completed down to the coal, but we have not been able to get any response to our application for a copy of their journal, and consequently cannot state definitely the thickness of the coal seam, or its depth below the surface. A. H. W.

afforded the following section, after passing through about seventy feet of soil and Drift:

		FEET.	IN.
1.	Light blue arenaceous shale	6	
2.	Hard, bluish, impure limestone, containing many small corals, etc	3	
3.	Black slate		10
4.	Coal	1	6
5.	Fire clay	6	
6.	Arenaceous shale	3	

The black slate which had been taken from the shafts was too much decomposed at the time of my visit for me to obtain from it any well preserved fossils, although amongst the rubbish I observed various indistinguishable fragments of what had apparently been fossil shells. The coal in this section is probably not below No. 6 of the Illinois river section, and may possibly be still higher. About four miles south of Lincoln, on the land of Mr. J. Braucher, near the center of the south line of sectien 14, township 19, range 4, a hole was sunk by boring to the depth of near two hundred and fifty feet, and three separate seams of coal were reported to have been met with. Unfortunately, however, the particulars of the variation and thickness of the beds could not be obtained, and we are therefore unable to form an opinion as to the equivalents of these seams. In a boring at Atlanta, in the northern part of the county, a seam three feet and six inches thick, was reported at the depth of two hundred and forty two feet, the overlying bed, as reported, consisting of alternating strata of "slate," "soapstone," "rock," (limestone?) etc. This is probably coal No. 6, although, without more positive evidence than is afforded by an isolated boring, nothing can be stated with absolute certainty.

The two shafts at Bloomington, which have been mentioned in the remarks concerning the Drift, in a previous portion of this chapter, afford us the most satisfactory section of any of the excavations in the district, enabling us to identify the two seams of coal which they penetrate, with numbers 4 and 6 of the general Illinois river section. The following section, made up from records afforded by both shafts, illustrates well the variation of the strata of the middle Coal measures in this region. This section commences at the base of the Drift, and its upper portion, from 1 to 4 inclusive, was afforded by the Bloominton Coal Company's shaft, and the remainder by that of the McLean county Coal Mining Company, a mile farther south, along the railroad track: *

---

* Since this report was written, the McLean County Coal company have extended their shaft down to a lower coal, which they struck at the depth of 513 feet 8 inches below the surface. The following is the section below No. 4 coal:

	FEET.	IN.
Fire clay	10	
Slate	8	

		FEET.	IN.
1.	Clay shale	16	
2.	Sandstone	32	
3.	Clay shale	1	
4.	Coal No. 6	4	
5.	Fire clay	13	
6.	Limestone	2	7
7.	Fire clay	10	
8.	Clay shale	8	
9.	Fire clay.	15	
10.	Shale	5	6
11.	Soft blue slate	22	7
12.	Black slate	5	
13.	Coal No. 4	4	6
14	Fire clay	6	9

No. 2 of this section is a light colored, laminated sandstone, containing a few remains of fossil plants; in the more southern shaft it seems to be replaced by a conglomerate. No fossils were obtained from any of the other beds excepting the black slate (No. 12) over the lower coal, which cantained, in great abundance, *Lingula umbonata*, *Aviculopecten rectalaterarea*, *Cardina? fragilis*, and other fossils characteristic of the shales of this coal. A rather peculiar feature, however, is the comparative rarity of *Discina nitida*, usually the most abundant fossil in this slate, only one or two specimens being found in a rather protracted search.

In the northern and eastern portions of McLean county, we have only the records of several borings, which afford but few particulars as to the character of the underlying beds. Just over the county line, in Livingston county,

---

	FEET.	IN.
Fire clay	4	6
Sand rock	20	6
Soap stone, (clay shale)	62	5
Black slate	2	7
Fire clay	1	7
Sulphurons rock	1	2
Gray slate	11	1
Shale	1	2
Hard, lime rock	2	1
Gray slate	2	8
Soapstone, (clay shale)	6	8
Coal	3	8

The distance between these lower seams is 133 feet and 1 inch at this shaft, and from the thickness of the seam, and the character of the associated beds, I am inclined to regard the lower coal in this shaft as No. 3 of the Fulton county section, given on pages 93 and 94. It is possible, however, that No. 3 is represented in this shaft by the 2 feet 7 inch bed of black slate, and that the lower coal here is really No. 2. A. H. W.

about two miles from Chenoa, in a northeast direction, a ledge of bluish-gray, irregularly bedded limestone outcrops in the side of a ravine. In general appearance this rock is very similar to that noticed in the preceding pages as occurring on Salt creek, in Logan county, and like it, is probably in the upper part of the Coal Measures.

Economical Geology.

Coal.—From the preceding remarks it will be seen that, although at least four or five different seams of coal underlie different portions of this district, but two of them have been worked to any extent. The upper of these two, No. 6 of the general section, is worked to a slight extent along the Illinois river, in the neighborhood of Pekin and Peoria, and is also the upper seam in the Bloomington shafts. Its thickness in these localities ranges from three to four feet. The coal in this bed is generally softer, and often more impure than that of the next seam below, and its workings have frequently been forsaken for those of the lower bed. The sixteen-inch vein of coal, which has been mentioned on a preceding page, as occurring on a ravine a short distance back of Wesley City, and which I have there considered as a still higher vein of coal, may possibly be this seam, in spite of its lesser thickness, as it is a characteristic of this bed, in other parts of the State where it has been identified, to vary considerably in its thickness, in some cases, indeed, thinning out very rapidly within the distance of a few feet. The more reliable indications of the accompanying limestone beds, with their characteristic fossils, cannot, under all circumstances, be well observed, nor, indeed, do they appear to be invariably present.

The lower coal, No. 4, is the seam which is now mined in nearly all the principal workings within the limits of this district, and will generally average here at least four feet in thickness. The coal is generally a harder and better heating material than that in the upper bed, besides being more reliable in its thickness. It, however, contains, in some parts, its share of impurities, but often so disposed in the vein as to be more easily separable. In some of the shafts near the city of Pekin, the seam of coal, which I have referred in the preceding pages to this horizon, contains in its lower portion, about sixteen or eighteen inches above the base, a thin seam of fire clay, separating it into two unequal portions, and sometimes a vein of slate, or slaty coal, is reported to occur only five or six inches above the bottom. In the upper portion, also, there is frequently some thickness of what is called "hickory," or mixed coal and shale, or sand rock. The thickness of good coal, however, is sufficient to render its working profitable.

At Bloomington the shafts were first sunk only to the upper coal, which was worked for a short time, and then the shaft having been deepened, the upper bed was abandoned, and only the lower seam was worked. The difference in quality was very marked at this place, the lower coal being very much superior to that of the upper seam.

Beneath this coal No. 4, we find, by the boring opposite Peoria, by Voris & Co., two seams of coal at the depths of one hundred and twenty and two hundred and thirty feet, and respectively four and three feet in thickness, which are most probably the equivalents of Nos. 1 and 3, of the general section referred to. Although we have no positive data, as to the existence of these, or other beds under the coal No. 4, in other portions of the district, yet, from their existence at this point, and from our general knowledge of the development of the lower Coal Measures in this portion of the State, it seems quite probable that these seams of coal might be found at the proper depth in other parts of this, and the adjoining counties. A boring of from two hundred, to two hundred and fifty feet, below the known horizon of No. 4, or from five, to seven or eight hundred feet from the surface in different parts of the district, would probably penetrate all the Coal Measures, and settle all the questions in regard to the existence, and develpment of the underlying coal seams.

The upper coal seams are perhaps represented in this district, by the bed reached in the Lincoln shaft, and it may be also by the small vein near Wesley City, in Tazewell county, which I have, in the preceding pages, referred with doubt to a higher level than No. 6, though still admitting its possible identity with that bed itself. In neither of these localities is the seam of sufficient thickness to be worked with much profit, excepting where it might, perhaps, be profitably worked in a small way by stripping along the line of its outcrop.

Building Materials.—This district, as a whole, is within itself but scantily supplied with building stone, the greater portion of its surface being occupied by the Drift deposits, and containing no exposures whatever of the older rocks. Along the Illinois river, however, in Tazewell county, the sandstones of the Coal Measures have been quarried to some extent to supply the local demand, and in some localities appear to afford a stone suitable for foundations, cellar walls, etc. The limestone beds which also occur in the Coal Measure strata in this region, though generally of inconsiderable thickness, may also furnish a limited supply for the same purposes, as well as for the manufacture of lime. The limestone ledges noticed as occurring on Salt creek and Lake Fork, in Logan county, also furnish a fair material for the rougher kinds of masonry, and have been considerably quarried for this purpose. Dimension stone, etc., when used in this dirtrict, are brought from beyond its limits, in great measure from the quarries at Joliet.

Clay and loam, suitable for the manufacture of a fair quality of red brick, are found in nearly all parts of the district, and have been made use of in most of the principal towns within its limits. Sand for building purposes is also sufficiently abundant.

Mineral Springs.—We may, perhaps, properly mention again, under this head, the artesian well sunk by Messrs. Voris & Co., on the edge of the bottom land along the Illinois river opposite Peoria, in which a current of water, holding in solution sulphuretted hydrogen, was struck at the depth of seven hundred and thirty-four feet. When struck it was stated to have had a head of sixty or seventy feet, and the flow is said to be nearly as strong at the present time. This water appears to be derived from the upper portion of the Niagara group, but before the boring had reached its present depth, a strong stream of saline water was met with, at a distance from the surface of three hundred and seventeen feet.

Copperas and saline springs occur in various places in this district, and occasionally give names to some of the minor streams. Such names as Salt creek and Lick creek occur here, as in other parts of the State. These springs, however, are few in number, and can hardly be considered of any economic value.

It is, perhaps, superfluous to mention at length the agricultural capabilities of this district, since the capacity of its soils, etc., are so well known, and its territory is so generally taken up by actual settlers and now under cultivation. I may safely say, however, that, with the exception of some sandy portions along the principal rivers, there are no extensive tracts of what can be called poor land in the district. There are, indeed, some tracts of comparatively low bottoms and marshy land, which are not at present available for all kinds of agriculture, but these are generally of limited extent, and are rapidly diminishing under an improved system of drainage, which places them at once among the more valuable lands of the district. The numerous railroads now traversing this region, and others projected or in process of construction, by making all portions readily accessible to the centers of trade, will add greatly to its present wealth, and guarantee its future prosperity.

CHAPTER XIII.

GRUNDY COUNTY.

Grundy county is bounded on the north by Kendall, on the east by Will and Kankakee, on the south by Livingston, and on the west by LaSalle. It includes twelve townships, or about 420 square miles, forming a rectangle of twenty-four miles long and about seventeen and a half miles wide. Of this, about two-thirds is slightly rolling prairie, and the balance mostly well timbered creek banks and river bottoms.

The Illinois river divides the county near the middle of its northern half, running in a W. S. W. course, with but little variation. Its principal affluent on the south is Mazon creek, which drains fully one third of Grundy, and portions of Livingston, Kankakee and Will counties. Its principal water supply is from surface drainage—but few springs being found along its course. From this character, one would readily predicate the truth, that a very wet season often causes it to overflow its banks, though twenty feet or more in hight, while a dry one leaves its bed bare, except where deep pools have formed. The summer of 1867, dryer than a score of its predecessors, gave me an unusually fine chance for the exploration of this stream, as well as all others included in this season's work.

A few miles west of the Mazon is the Waupecan, draining a comparatively small extent of country; but, in an ordinary season, carrying nearly as much water, the product of several strong springs on the lower part of its course—some of them from the Drift, others from the sandstones and shales of the Coal Measures, which here show a small outcrop. Still farther to the westward, are Billy run, Hog run and Armstrong run, which are simply prairie drains, and show no outcrop of rock. Nettle creek, on the north side of the river, is principally of the same character; but in the lower part of its course, there are a few springs, and two or three outcrops of the shales and sandstones which overly the lower coal. Finally, in the northeast corner of the county, is the Au-Sable creek, with a comparatively large amount of water, partly derived from springs, and partly from drainage of this and part of Kendall county.

Post-tertiary Formations.

Alluvium.—The beds of this formation are very largely developed in the terraces of the river valley and the beds of the smaller streams. From the west line of the county nearly to AuSable creek, the Illinois and Michigan canal follows the north bank of the present river valley pretty closely, while the second terrace varies from a half mile to two miles to the northward. On the south side of the river, the high, gravelly banks of the second terrace hug the river banks very closely, as far at the Waupecan creek. Here they lose much of their elevation, and have as their continuation a low ridge, about a mile distant from the present bank. East of Mazon creek this declines still more, and becomes the heavy sand ridge which bears still farther southward, and then eastward, south of Wilmington, into Kankakee county. This sand ridge forms the watershed between Mazon creek and Kankakee river, so that, where it strikes the bank of the latter stream, to the southward of Wilmington, the water flows from within two hundred yards of the river, through swamps and sloughs, and finds its way, through the Mazon, into the Illinois, opposite Morris.

The flats of the old river valley, back of the present banks, show, in many places, plain evidence of the comparatively recent date of their formation. At Gen. Birney's place, on section 11, town 33 north, range 6 east, my attention was called to the fact, that at a short distance beneath the surface, at a pretty uniform depth through that neighborhood, there is a layer of thin slabs of the fissile sandstones of the Coal Measures, still tolerably solid. They were evidently distributed here by the current of the river, not long before it became so contracted as to leave this level dry. When this old channel was the outlet of Lake Michigan, a large body of water must have flowed through here, and appearances seem to indicate that its diversion toward Niagara must have been sudden, rather than gradual; otherwise, the present valley would probably have been wider, and the descent to it less abrupt.

A topographer would take peculiar pleasure in studying the various islands of the old valley, especially at the confluences with the Illinois of AuSable and Nettle creeks, both of which streams, apparently, were much larger than at present. Upon one of these islands stands Morris, the county seat.

Another, and far the largest in the county, is the high land lying between the head of the Illinois, the lower part of the Kankakee, and the slough which contains Goose Lake, and runs thence to Pine Bluff, near the embouchure of the Mazon, upon the Illinois valley.

The following levels of points within this county have been furnished to me, mostly from the notes of the Illinois River Survey, from the office of its chief, Gen. J. H. Wilson, U. S. A., now in charge of the river improvements at

Keokuk, Iowa. The figures indicate distances *below* the established "*datum* of six feet below the lowest registered water of Lake Michigan:"

	FEET.
Bluffs at Morris, north side (level of town)	55.938
" south side	59.48
" " lower terrace	78.00
Level of river, at head of the Illinois	87.809
" mouth of AuSable creek	92.664
" Morris, under road bridge	95.18
" Marseilles, LaSalle county, above dam	99.808
" " " below dam	103.256
" Goose Lake, about	60
" Minooka, as per railroad survey, *above datum*	35

These levels show that the elevation of the first terrace above the river, opposite Morris, is a little over seventeen feet, and that the elevation of the second bluff or gravel ridge above the first terrace, is about eighteen and a half feet. The present floods reach nearly up to the first terrace, and it is probable that when the lake poured its waters through here, even the much wider valley of the old river did not so accommodate the floods as to prevent their nearly or quite overflowing the gravel ridge, and covering large portions of the upper terrace, both north and south of the river.

The coarser portion of the beds of river gravel consists mostly of fragments of the Niagara group limestone, which forms so heavy beds, from below Joliet to Chicago and beyond. Much of the sand is probably due to the disintegration of the Coal Measure sandstones, while some of it may have come from the northward. There is, however, in these beds, but a very small proportion of the metamorphic material from Canada, which forms so large a part of the true Drift, but, upon the *surface* of the soil, and often partially buried, are great numbers of small boulders of quartzite, gneiss, granite and trap, unquestionably of northern origin. These are especially abundant south of Goose Lake, over the surface of the valley which starts from the Kankakee, near the county line, includes Goose Lake, and joins the Illinois valley near where the Mazon first strikes the bottoms. This was probably a shallow channel, in which floating fields of ice lodged, melted and dropped the loads of stone which they had brought from the northward. Similar aggregations of boulders occur in the adjacent parts of Will county, at points where eddies would have been likely to detain the ice floes. I have suspected that this Goose Lake channel was formerly the main channel of the Kankakee, which thus met the DesPlaines only four miles above Morris; but I have not collected sufficient data to decide the point.

The bed of "potter's clay," worked near the southwest bank of Goose Lake, and lying "near the level of the fire clay," (see vol. i., p. 58) owes its origin and deposition to river action, though principally consisting of the decomposed shales and fire clays of the Coal Measures.

During the autumn of 1868, the remains of a *Mastodon* were found at Turner's strippings, about three miles east of Morris, under eighteen inches of black mucky soil, and about four feet of yellowish loam, and resting on about a foot of hard blue clay which covered the coal. The bones were badly decayed, and most of them were broken up and thrown away by the miners; of the remainder, Mr. Joseph Even, of Morris, with his usual zeal for science, obtained and presented to the State Cabinet, a part of a thigh bone, a fragment of a lower jaw, three teeth, and a few of the small bones. The locality is a portion of the old river bottom, and, in the lack of personal observation, I am uncertain whether to believe that the presence of the bones indicates that the animal was mired and died here, or to suppose that the carcass was deposited here by the river.

The Coal Measure rocks of this county are too soft and too readily disintegrated to allow of the preservation of any scratches that may, at any time, have been impressed upon their surface; so that, although we find in the gravel very numerous scratched and polished pebbles and boulders, it is within only a very small area that striated and polished rock surfaces have been noticed. In the southeast quarter of section 23, township 34 north, range 7 east, at Waters's quarry of Trenton limestone, smoothly polished surfaces have been frequently met with. In the southwest quarter of section 16, township 34 north, range 8 east, Collins's run exposes a small surface of the shaly limestone of the Cincinnati group, upon which are plainly marked three sets of striæ, running, by compass, north 30° east, north 37° east, and north 50° east. In the southeast quarter of section 19, of the same township, the surface of the black slaty shale which overlies the coal at Pettys's shaft, is scratched and polished in a similar manner. As these three localities, however, are all within the old river valley, we cannot, with certainty, predicate upon these facts the conclusion that those scratchings and polishings are attributable to glacial action. In fact, these and some other circumstances give some reason for assuming that they are results of river action alone. At the coal mine, we find the outer portion of the shale, next to the creek bank, broken up for several feet, and thoroughly mingled with the drifted materials which here form an overlying bank of about fifteen feet. This disturbance, as well as the grinding of the surface, we may fairly attribute to the action of the creek while at its former level. But, while allowing that, in these particular cases, river agencies are sufficient to account for all observed phenomena, we must also record the frequent occurrence in the Drift gravel of large and small boulders unquestionably planed and striated by glacial action. These are especially abundant along the Mazon.

The True Drift, in the western part of the county, consists, mainly, of the tough blue "boulder clay," with pebbles and boulders, sometimes also including fragments of wood, overlaid but slightly, or not at all, with gravel, and underlaid, so far as known, with a bed of "hard-pan," and a water-bearing quicksand which has thus far prevented any knowledge of the underlying materials. The eastern part of the county, on the contrary, shows but little boulder-clay, this being replaced by a heavy layer of sand and gravel. Township 34 north, range 6 east, has no known outcrop of rock, and wells near its south line have reached depths of forty-eight, fifty and fifty-two feet, before meeting the quicksand. Townships 31 and 32, of the same range, and so much of 33 as lies south of the river, together with townships 31 and 32, range 7 east, possess no outcrop of rock, but the depth of the Drift is not known. At Gardner, in section 9, township 31 north, range 8 east, the Drift is said to be one hundred feet deep at the coal shaft. At Braceville, section 25, township 32 north, range 8 east, it was found to be forty-four feet deep. Going northward into townships 33, in ranges 7 and 8, it rapidly thins out, owing partly to the downward slope of the surface, partly to the upward slope of the surface of the underlying rocks, which come to the surface in the northern part of these townships. Much of the "coal land" in the immediate neighborhood of Morris is bare of drift, having been stripped by the old river. To the northward, however, through township 34 north, range 7 east, the gravel and boulder-clay lie, in some places, forty feet deep. Township 34 north, range 8 east, is deeply buried in Drift; at Minooka, on the line between sections 1 and 2, a well-boring found one hundred feet of gravel overlying the shaly limestone of the Cincinnati group.

Rock Formations.

Coal Measures.—The beds of the Coal Measures occupy far the larger part of the surface of the county. The outcrops, however, are so disconnected, and the beds so irregular, that I have been unable to construct any general section to represent connectedly all the outcrops. Apparently, the higher beds exposed in the county are those which outcrop near the old coal openings on the Waupecan, in the southeast quarter of section 20, township 33 north, range 7 east. I was unable to find any outcrop of beds above the coal, and did not learn whether any were seen in the deeper parts of the mine. Near the outcrop, a foot of coal was left as a working roof. The seam is five feet thick, resting on a bed of fire clay. It is coal No. 4, of the Illinois valley section. The connection below is not exposed, but, at a short distance from the floor of the seam, not over ten feet, we came upon a coarse, ferruginous, shaly sandstone, filled with fragments of *Lepidodendron*, *Calamites*, *Neuropteris hirsuta*, etc., with an occasional streak of coaly matter. Of this bed, there is a low, nearly continuous outcrop for a mile up the stream, the last spot observed being at "Hog-grove quarry," in the southwest quarter of section 28. At the road crossing, about half a mile down the creek from the coal mine, the sandstone rises a little, and exposes about six feet of blue and black shales, filled with small Mollusca of the genera *Pleurotomaria*, *Macrocheilus*, *Euomphalus*, *Orthoceras*, *Nucula*, *Aviculopecten*, *Productus*, *Chonetes*, *Hemipronites*, etc., and yielding some small remains of fish, such as *Petrodus occidentalis*, and the type of the new Crustaceon, *Ceratiocaris? sinuatus*, M. and W. The lower part of the blue shale holds two thin layers of rusty brown nodules of carbonate of iron, which often partially or wholly include shells of the above named Mollusca. The upper part of the black shale also contains nodules of the same material, (with probably some phosphate of lime,) but smaller and less evenly distributed; the smaller of these contain comminuted scales and bones of fishes, and judging from both form and contents, are probably the fossil excrement of larger fishes. These beds, with others, outcrop at intervals for about a mile along the right bank of the stream; and the following section will fairly represent the whole:

		FEET.
1.	Sandy shale	5
2.	Blue clay shale	3
3.	Fissile sandstone	15
4.	Blue clay shale, with iron nodules	2 to 5
5.	Black shale, top slaty, with small nodules, bottom very fragile	2 " 3
6.	Cone-in-cone, locally becoming a solid limestone	½ " 1½
7.	Soft olive shale	1½
8.	Solid gritty sandstone	1

Another outcrop, on nearly the same horizon, occurs on Morgan creek, from the center of the south line of the southwest quarter of section 6, township 32 north, range 8 east, to near the center of the south line of section 25, township 33 north, range 7 east. The strata are here very irregular in thickness, but the following section gives an average representation of the exposed outcrop:

		FEET.	IN.
1.	Ironstone conglomerate, (local.)		6
2.	Sandstone	8	
3.	Black shale, some slaty, with large ironstones	3 to 4	
4.	Cone-in-cone, running into massive limestone.		2 to 6
5.	Olive shales, changing into concretionary argillaceous limestone	5 " 7	
6.	Soft black shale	2 " 3	
7.	Blue clay shale		9
8.	Coal No. 3?	2	
9.	White fire clay	?	

Small quantities of coal have been mined at this seam at several points along the limited outcrop. The latest opening was by Mr. Herald, for his own use, just back of his house, on section 1, township 32 north, range 7 east. The coal was said to be good house fuel, but rather soft; none could be found at the time of my visit. The argillaceous limestone of No. 5, of this section, generally contains numerous shells of the genera *Productus*, *Athyris*, *Terebratula*, etc., and some fragments of crinoids. The coal apparently holds the position of the thin coal which locally underlies No. 56 of the LaSalle county section. (See Vol. iii, p. 267.)

The outcrop along the Mazon appears nearly continuous, but still I have not been able to satisfy myself as to the connection of the above beds with those of the lower part of the stream. The strata there developed consist of very variable sandy clay shales and sandstones, in some places becoming nearly pure clay shales, but containing many nodules of carbonate of iron. Pine Bluff, at the lowermost crossing of the Mazon, is composed of about forty feet of heavily bedded, but rather fissile sandstone, partly nearly white, partly highly ferruginous. Less than a mile up the creek, the lower part of this bed changes to highly argillaceous sandy shales, with occasional streaks and nodules of sandstone. The section is not quite continuous, but there is no distinct line of demarcation to separate these latter beds from the ferruginous sandy shales, twenty to thirty feet thick, of section 24, of township 33 north, range 7 east, which contain large numbers of the fossiliferous nodules of carbonate of iron, for which this locality has become famous. Besides the many species of ferns, which are named in Mr. Lesquereux's report, in this volume, the nodules also contain the fossil insects, *Miamia Bronsoni*, *M. Danæ*, *Hemeristia occidentalis*, *Chrestotes lapidea*, *Mylacris anthracophila*, *Megathentomum pustulatum*, *Euphemerites simplex*, *E. gigas*, *E. affinis*; the Myriapods, *Euphoberia armigera*, *E.? major*, *Anthracerpes typus*; the Arachnids, *Eoscorpius carbonarius*, *Mazonia Woodiana*; the Crustaceans, *Anthrapalæmon gracilis*, *Palæocaris typus*, *Acanthotelson Eveni*, *A. Stimpsoni*, *A. inæqualis*, *Euproops Danæ*, *Eurypterus*, (*Anthraconectes*,) *Mazonensis*; the Worm, *Palæocampa anthrax*; the Salamander, *Amphibamus grandiceps*, with three or four undescribed Fish and Ostracoid Crustaceans. It is thus evident that this is one of the richest deposits of Carboniferous Articulates ever discovered, if not *the* richest.

These nodules range from about two to about ten feet above the main coal seam of all this region, the intervening space being occupied by the soft, blue clay shales, filled with fossil plants, which, at most points, overlie this seam.

About a mile farther up the stream, coal has been dug in the bed and banks of the stream, but is now abandoned. Still farther south, near the southeast corner of section 19, township 33 north, range 8 east, a shaft was recently sunk, by Mr. Wm. Burt, upon the creek bottom, starting at about twenty-five feet below the general level of the prairie. The section is as follows:

	FEET.	IN.
Blue clay and sandy shale, with ferns	20	
Coal	8	
Soft black shale		6 to 8
Fire clay, with rootlets		6 " 8
Hard, sandy clay		8
Fire clay	2	6

At this place, the coal is about eight feet below the bed of the creek. Near the water level, an offshoot from the main seam, about seven inches thick, is exposed in the bank; the shales immediately over it afforded a few plants.

Near the center of section 18, township 33 north, range 8 east, Mr. John Holderman's artesian well has afforded the following section, kindly furnished by Mr. A. J. Henry, who had charge of the boring:

	FEET.
Gravel	15
Sandstone	34
Coal	3
Sandy shale	88
Limestone	185

It will be noticed that this section gives the sandstone as immediately overlying the coal. This condition of the seam has been elsewhere noticed, so far as I can learn, only in a shaft recently sunk near the southeast corner of section 9 of the same township, and in one shaft in the adjoining part of Will county.

Mr. Henry has also furnished me the section of the well bored by him at the railroad station in Morris, from which an abundance of water is now flowing, as follows:

	FEET.	IN.
Shale, with sandstone layers	63	
Coal	2	10
Fire clay	4	
Shales and clays	100	
Hard limestone, "Trenton."	200	
White sandstone, "St Peters."	37	

On the north side of the Illinois river, in the neighborhood of Morris, the coal outcrops in the bank of the canal, and in the stretch of low land about one mile to the northward. The overlying beds are here mostly blue clay shales, with occasional irregular layers of sandstone. The iron nodules, above mentioned, occur here at the same level, but not in so great numbers as at the Mazon locality. The shales immediately above the coal frequently yield magnificent specimens of fossil ferns and other plants. The following section of the seam and its overlying beds was obtained at the shaft of Messrs. Symonds & Jones, just south of the railroad station at Morris:

	FEET.
Boulder clay	8
Ferruginous sandstone	1
Shale	20
Shaly sandstone	19
Shale, filled with fossil ferns	12
Coal	3
Soft slaty coal	1
Fire clay	3

In the north part of township 33 north, range 6 east, the shaly sandstones, overlying this seam, are exposed in the bottom of every little run which cuts away the soil from the edge of the second terrace, and fragments of them are found scattered just below the surface over the whole lower flat.

It has long been a favorite theory with miners that another seam of coal could be found, by sinking shafts in the bottom of the present working. This is not impossible, at points farther from the outcrop; but at Morris, and to the eastward, the coal lies directly upon Lower Silurian rocks, with only four or five feet of fire clay to separate them. This is shown at several points.

I had supposed that the seam had formerly extended, in its full thickness, much further northward; but two wells, one in section 27, and the other in section 13, township 34 north, range 7 east, after passing through the fossiliferous shales which overlie the coal, met with only about ten inches of soft coaly shale, underlaid by a few inches of greenish clay shale, with small rounded grains of calcareous (?) matter, (probably belonging to the Cincinnati group,) which rested upon the solid limestones of the Trenton. The artesian boring of Mr. Samuel Holderman, in the northeast quarter of section 3, township 33 north, range 8 east, after passing through forty-seven feet of the sandstone and clay shales which, everywhere to the southward of that point, overlie the coal, passed directly into a solid limestone which I can only refer to the Trenton group. From these and similar facts, I am led to the conclusion that the present line of workings corresponds very nearly with the original outline of deposit of the true coal seam, while beyond this line, only occasional small outlying patches will ever be found, though thin layers of coaly shale may be met with some miles further northward. On the AuSable creek, a few miles north of the county line, small quantities of coaly shale and cannel coal have been found, but they are probably of no practical value, and have no direct connection with the Morris seam.

Upon the lower part of the AuSable, however, in the southeast quarter of section 19, township 34 north, range 8 east, there is a peculiar outcrop of probably the lower seam. We have here a seam of coal twenty-eight inches thick, with a floor of fire clay at least six feet thick, and a roof of black shale which is, at the outcrop, quite solid and a foot thick; but, at the shaft, perhaps fifty yards distant, it thickens to between five and six feet, and becomes quite soft. This shale has yielded a few small *Discinæ* and *Lingulæ*, and a few fragments of fish scales; but these are not sufficient to determine its position in the series. The bed seems to be but a small outlier, covering only a few acres, as borings to the southward and westward have failed to find any continuation of the bed in these directions, while to the northward and eastward, the shales and limestones of the Lower Silurian, outcrop within a few hundred yards. I am still uncertain whether this is a locally peculiar condition of the main seam, or lies above or below it. If it be the main seam, the black roof shales are probably the equivalent of the bed mentioned in the LaSalle county section as lying there about eighteen feet above the coal; but no other outcrop of it has been seen in this part of Grundy, though it appears in Wilson's shaft in the southeast corner of the county.

Another peculiar outcrop, of uncertain connections, is along the Kankakee, from the east line of the county to the "Head of the Illinois," in section 36, township 34 north, range 8 east, where the river has cut through some fifty feet of shales and sandstones of the Coal Measures, including a thin seam of coal, and has reached the underlying shaly limestone of the Cincinnati group. A few indistinct plants have been met with in the sandstone, but in too poor condition for specific determination. The following section was taken on the west bank of the river, about midway of the length of the exposure as above named:

		FEET.	IN.
1.	Soil and gravel	2	
2.	Boulder clay	2	
3.	Dark purplish shaly clay	2	
4.	Ferruginous shale		3
5.	Coal		10
6.	Coaly shale, with thin layers of sandstone	8 to 10	
7.	Sandstone		6
8.	Gypsiferous clay		3
9.	Olive shales	3	
10.	Ash colored shales, with limestone nodules	8	
11.	Limestone of Cincinnati group		

In other parts of the outcrop, the ash colored shales, No. 10, contain as many as six distinct layers of the limestone nodules, which appear like good material for making hydraulic cement. The sandstone No. 7, thickens to the southward, and forms at least fifteen feet of the bluff at Schoonmaker's ford, on the county line, where it contains many spherical concretions, both large and small, and a few indistinct *Lepidodendra* and *Calamites*. The coaly shales, No. 6, become more carbonaceous in the same direction, and finally are replaced by a true coal, which, with No. 5, forms a layer which is known in the neighborhood as the Schoonmaker coal, and is found to be ten and a half feet thick at Schoonmaker's shaft, near the center of section 7, township 33 north, range 9 east. Its relation to other seams are still doubtful. (See further, Report on Will county.)

In ascending the DesPlaines river, from its junction with the Kankakee, the sandstone of the above section, No. 7, is found at intervals for about two miles on the south bank, but does not cross the river above the "feeder" aqueduct, at Old Kankakee.

The outline of the Coal Measures in this county, may be roughly stated as a line running from near the northwest corner of the county, with some variations, in an east southeast course to the mine on AuSable creek, just above the railroad; thence, southeasterly to the Goose Lake slough, and easterly to the east end of the lake; thence, northerly to the mouth of the Kankakee.

Cincinnati Group.—The shales and shaly limestones of this group outcrop in the northeastern part of the county, showing most prominently upon the high ground between Goose Lake and the Head of the Illinois. This outcrop consists of coarsely granular, highly fossiliferous, ferruginous limestones, readily disintegrated by the weather, which have been used, to some extent, for fences. This outcrop continues southward for about a mile, and forms the bottom of the north half of Goose Lake, the south half being underlaid with coal. At the ford of the Kankakee, in the northwest quarter of section 36, township 34 north, range 8 east, beds of soft blue shaly limestone, which probably lie near the base of this group, outcrop in the bed of the river, but show little upon the bank, and contain but few and indistinct fossils.

From the bed of the canal, a half mile west of Dresden, there were thrown out considerable quantities of a heavy, but rather cellular ferruginous limestone, in heavy layers, probably belonging below the beds above mentioned. The outcrop at this point, did not quite reach the surface. Over most of the county, north of the Illinois, the Alluvial and Drift deposits cover the country so deeply as to allow of outcrops only along the streams. In ascending the AuSable creek from the railroad, we frequently see scattered fragments of the shaly limestones of this group, but meet with no outcrop until we approach the middle of section 3, township 34 north, range 8 east, where small quantities of stone have been quarried for wells and under-pinnings. From this point there is a nearly continuous outcrop to some distance above the county line. Fossils are numerous, such as *Chætetes lycoperdon*, *Pleurotomaria bilix*, *Orthis testudinaria*, *Leptæna sericea*, *Ambonychia radiata*, *Calymene senaria*, etc. These beds were struck at one hundred feet, in a boring through the boulder clay at Minooka.

A small outcrop of rock of this age is exposed in the bed of Collins's run, a branch of the AuSable, in the southwest quarter of section 18, of the same township. The rock here is a rather more solid limestone, breaking irregularly, and containing but few fossils. It is reported that similar small outcrops occur farther up this run, but they have not been opened, so as to know whether stone of any value can be obtained. Similar outcrops were observed in the bottoms of ditches near the middle of the north line of township 34 north, range 7 east. In the borings about Morris, only a few feet of beds which can be referred to this group are found between the Coal Measures and the underlying Trenton limestone, and to the northward of that place, no such beds have been found.

Trenton Limestone.—The two remaining outcrops of rock in this county are limestones of the Trenton group, probably near its top. The principal one is near the center of section 24, township 34 north, range 7 east, where Mr. H. Waters has, for some years, quarried stone for building and for making lime. The top layers of the quarry are thin, and somewhat stained with iron. Below these, the rock is a heavily bedded, gray or light drab, fine grained, clinking limestone, not very rich in fossil, but yielding some good specimens of *Receptaculites*, *Illænus*, *Strophomena*, *Leptæna*, *Orthis*, *Discina*, *Murchisonia*, *Orthoceras*, etc. These have been penetrated to the depth of twenty feet, without exposing any other layers; but it is said that at one point the drill passed into a pocket of a softer black material, which strengthened the owner's previous opinion that the coal seam extended under his quarry. Possibly this may have been a small deposit of carbonaceous material analagous to the petroleum which this rock has yielded in small quantities in the adjoining county of LaSalle. These beds contain small portions of pyrite (sulphid of iron) disseminated through the whole mass. There were also occasional streaks of soft clay. The quarry has exposed two sets of crevices, one tending south 45° west, and the other south 35° east. These crevices are filled with a fine clay, of very nearly the same color as the limestone, through which are sparsely disseminated small crystals of blende (sulphid of zinc,) with occasional pyramidal crystals of pyrite; no galenite has been observed.

The remaining outcrops of this rock are in the beds of the AuSable, on the two sides of the yoke-like bend of the stream, in the east half of the northeast quarter of section 19, town 34 north, range 8 east, and consist of small patches of a thin-bedded, fine-grained limestone, containing but few fossils.

In the Morris boring, the Trenton limestone is two hundred feet thick.

St. Peters Sandstone.—This rock has been struck at the railroad station in Morrs, at a depth of about three hundred and seventy feet, and here, as elsewhere in this region, has furnished a constant and abundant supply of artesian water.

Economical Geology.

Under this head we have to consider coal, potter's clay, brick, building stone, lime, hydraulic lime, iron ore and water.

Coal, as already stated, underlies fully three-fourths of the county, the seam averaging about three feet, except on the borders of the field. It is very largely worked in the immediate neighborhood of Morris, by from twenty-five to thirty shafts—twice as many are now deserted—varying from thirty to sixty feet in depth, and several extensive "strippings." Some of these strippings uncover coal thirty inches thick, which is about the average thickness in this neighborhood; while others, on the borders of the outcrop, find not more than eighteen inches. West of Nettle creek timber, no shafts have been opened, though the seam cannot be anywhere, on this side of the river, more than eighty feet below the level of the canal, and in most places much less than that. A well on Gen. Birney's place, four miles west of Morris, stopped, at a depth of thirty feet, in soft, blue clay shales, apparently only a few feet above the coal.

A smaller cluster of shafts and strippings is found to the south and west of Goose lake, with the average thickness of full thirty inches. At a stripping in the southwest corner of section 12, town 33 north, range 8 east, the bed is locally thickened to over four feet, but contains, near its center, a heavy band of crystalline carbonate of iron and lime, with much disseminated pyrite. The coal covers the bottom of the south half of Goose lake.

This seam is also worked at Braceville, (section 25, town. 32 north, range 8 east,) by a shaft ninety-eight feet deep, and in section 26 of the same township, by a shaft of one hundred and ten feet. At Gardner, (section 4, town. 31 north, range 8 east,) it is worked by a shaft one hundred and sixty feet deep. In the southeast corner of this township, three or four shafts, of about sixty feet each, work this seam in its usual condition; but one, in the northeast corner of section 25, finds a roof of black, slaty shale, with heavy iron-stone concretions covering about three feet of a very pure "block coal," with much mineral charcoal in the partings. Both the coal and the accompanying beds, at the mine on AuSable creek, closely resemble the conditions found here; and at both points I have been unable to decide whether they represent a local change of the main seam, or are portions of a lower seam which is only occasionally present. I at present favor the former view.

The upper seams, which have been worked upon the Waupecan creek, and upon the Mazon, near the mouth of Johnny run, apparently occur over only small areas at either locality; and elsewhere, whenever met with, they have proved to be irregular seams, locally quite thick, but often running out to a mere streak of coaly matter, and even disappearing altogether. It is probable that the Waupecan bed is nearly exhausted, but other portions of the seam will probably be found farther southward, if borings or shafts should be sunk. The Mazon seam is, apparently, the equivalent of a seam which, on the eastern side of the coal-field, in the Wabash valley, is usually too thin to work, except at a single point, where it reaches twenty-two inches. Still, as it lies near the surface, and is reputed to be good fuel, it will probably be mined, to some extent, as population increases in that part of the county.

The outcrops are not sufficient to give any exact data as to the dips, but I see no reason to believe that the main seam lies at a greater depth than two hundred and fifty feet in any part of the county, and I doubt whether it is any where so deep as that. Whenever, therefore, any portion of the southern part of the county becomes so thickly settled as to create any considerable demand for coal, it can be obtained on the spot without much difficulty. This seam is of pretty constant thickness, at every point where it has been opened, and the miner can rely upon finding a paying thickness of coal at almost any point in this part of the county, even if he sink his shaft without the usual preliminary boring. At many points, also, one or more of the upper seams would be found much nearer the surface, with from two to nine feet of coal.

In the openings of this county, as elsewhere, the miner is often troubled with "faults" and "rolls," which interrupt the regularity and even the continuity of the seam. Upon the outer edge of the field, near Morris and to the eastward, the dip of the seam is very variable and irregular, which greatly interferes with the drainage of the mines in many cases. Much of this seems to have resulted from the irregularity of the denuded surface of the Silurian rocks upon which the coal was deposited; but, in one or two cases, I have been led to consider the contortions as the result of the removal of the subjacent limestone by solution in subterranean streams after the deposition of the coal. This is the only solution which I can devise for the reported condition of the seam, in a shaft a short distance east of the Jugtown pottery. In this neighborhood, the seam is generally about twenty feet below the surface; but, in the shaft referred to, it was found forty feet down, and after yielding about three hundred bushels, the coal ceased abruptly, on all sides.

So far as known, all the coal mined in the county contains more or less pyrite —"sulphur," of the miners—and streaks of calcite; but this is so variable, even in neighboring portions of the same mine, that it would be useless to attempt to discriminate between the products of the different shafts. "Stripped" coal is always inferior to that from a shaft of considerable depth, from its greater exposure to atmospheric and aqueous influences. As a whole, the product of the main seam is a fine steam and grate coal, and is largely shipped to the Chicago market, the distance being only sixty-two miles. The Waupecan coal, not now mined, is said to have made much less "clinker" than the lower seam, but its yield of ash was very much greater, being from six to eight per cent., while that of the lower seam is from one to three per cent.

Brick.—There are several large brick-yards near Morris, which manufacture brick from the decomposed shales which overlie the lower coal. As these beds contain considerable calcareous matter, the brick are not very firm, and do not stand the weather well. It would appear probable that the fire clay below the coal would make a better article. This has not been tried at Morris, but at the Gardner coal shaft the manufacture has been recently commenced. The fire clay, and soft clay shales underlying it, are said to be thirty-five feet deep, and so much of these beds as may be convenient, in mining the coal, is dug out and used promiscuously. Without thorough grinding, therefore, in the pug-mill, the bricks are variable in character and irregular in burning.

Potter's Clay.—The only bed known and worked, is that previously noticed, as occurring near the west end of Goose lake, and extensively used, at Jugtown, in the manufacture of a good grade of domestic earthenware, together with drain-tile and sewer-pipes. The bed consists of more or less thoroughly decomposed clay shale and fire clay of the Coal Measures, containing many fragments of coal, thoroughly mingled, and deposited in a low part of the old river channel, which contains Goose lake, by the current of the river which formerly flowed there. The mixed character of the materials has given much trouble to the potters. The bed has been worked to a depth of about fifteen feet.

Building Stone.—The only considerable source of building stone in this county is Waters's quarry of Trenton limestone, in Saratoga, about four miles northeast of Morris. This yields an abundance of a light gray or drab, massive limestone, which has been extensively used for foundation walls, and in a few cases also for the superstructures. It appears fitted to stand the weather as well as any ordinary stone. It is said to dress well.

The Cincinnati group, along the AuSable creek, near the county line, yields small quantities of stone for wells and foundations, but nothing suitable for superstructures. Beds of the same group upon the northern side of Goose Lake, have been quarried slightly, for similar purposes.

Upon the bank of Waupecan creek, in the southeast quarter of section 18, township 33 north, range 7 east, Mr. Starr has quarried small quantities of a very solid limestone, No. 6, of the Waupecan section, as given above.

A sandstone, representing Nos. 1 and 3 of the same section, has been quarried to some extent for foundations, on the upper part of the stream, at Hoggrove quarry, and has given good satisfaction; though where exposed to the weather, it crumbles rapidly. The same defect exists in the sandstone of Pine Bluff.

All deficiencies in this respect, however, can be readily supplied from the neighboring quarries of Joliet.

Lime.—The limestone of Waters's quarry is burned for lime in large quantities, and is said to furnish a very good article, though care must be taken to exclude from the kiln the more ferruginous layers.

Hydraulic Lime.—The only hydraulic limestone found in the county occurs in nodules along the Kankakee, and in very small quantity. The abundant supply of this material from LaSalle county, makes these deposits valueless.

Builder's Sand can be obtained in limitless quantities from the sand ridges of the river valley. From one of these ridges, about one mile south of Morris, large quantities of *road gravel* are also obtained.

Iron Ore.—The ironstone nodules (carbonate of iron) of the Mazon and Waupecan, are not sufficiently abundant to supply a furnace; and the bog-ore, noticed near Waters's limestone quarry, has not yet been tested for either quantity or quality.

Water.—In a dry season, large portions of this county are very scantily supplied with water. In ordinary seasons, wells running ten or fifteen feet into the top of the Drift, supply all needs; but in the western part of the county, reliable wells can be obtained only by passing through the boulder clay to the underlying quicksand. The lower seam of coal is everywhere accompanied by an abundance of water, which is pure and good, until the working of the coal exposes the accompanying pyrite to decomposition. A well recently bored at the tile factory in Jugtown, struck the coal at about thirty feet, and gave exit to a strong stream of water highly charged with sulphuretted hydrogen. Small springs of similar character are said to accompany the supposed line of outcrop of this coal seam, along the foot of the first terrace, from Mazon creek nearly to the Morris bridge. A very strong spring of this character flows from beneath the Drift gravel, over the black shale, No. 3, of the Upper Mazon section, in the southwest quarter of section 6, township 32 north, range 8 east, leaving a heavy white deposit of sulphur on the surface of the shale.

The artesian boring of Mr. Samuel Holderman, on the northeast quarter of section 3, township 33 north, range 8 east, brings to the surface a small, but constant supply of slightly sulphurous water from the upper part of the Trenton limestone, at a depth of about one hundred and thirty-seven feet. Mr. John Holderman's well, on section 18, of the same township, has met with no flowing water at 325 feet, after penetrating one hundred and eighty-five feet of the Trenton limestone. The more recent successful boring at Morris, shows that this limestone is two hundred feet thick, and that in this county, as well as in LaSalle, to the west, and Will, to the east, the underlying St. Peters sandstone is full of pure water, which is ready to flow to the surface wherever it is tapped. This abundant supply can be reached anywhere in the northern part of the county at about four hundred feet, and in the southern part, at probably nowhere more than six hundred feet, and in part of it, much less than that. Any one boring for this in the prairie, where drainage cannot readily be had in every direction, should be careful to so locate his well as to avoid the fate of certain residents of Iroquois county, who have allowed the surplus water of their wells to saturate the soil of their orchards, and so drown their trees.

"Gas" wells in the boulder clay are known at two localities. Near the northeast corner of section 3, township 32 north, range 6 east, Mr. Whitton's well, at twenty feet, gave off so much carbonic acid as to prevent farther excavations. Probably this flowed from some ancient soil, like the muck beds encountered in Livingston, Champaign and McLean counties. On section 35, township 34 north, range 6 east, Mr. Cassel's well, at forty-seven feet, gave off light carburetted hydrogen with so much noise as to be heard at a considerable distance, and in such quantity as to blaze "as high as the house," for some fifteen minutes after being approached with a lighted candle. The gas still flows freely, though it is several years since the well was dug, and a wagon-load of gravel has been thrown in to act as a filter for the water, which was at first filled with quicksand, brought up by the ebullition of the gas. Similar phenomena have been observed in wells recently dug, about a half a mile farther south. Near the south line of section 22, in the same township, on land of Mr. Samuel Hodge, is a large spring which constantly gives off bubbles of this gas. Springs of this character have been found by Capt. H. C. Freeman, to accompany the outcrop of the lower seam of coal, in the adjoining part of LaSalle county, and I am inclined to accept them as partially indicating the coal outline here, where the depth of the Drift prevents actual observation of its position.

CHAPTER XIV.

WILL COUNTY.

Will county is bounded on the north by Cook, on the west by Kendall and Grundy, on the south by Kankakee, and on the east by Kankakee and Cook counties, and the State of Indiana. Its form is very irregular, its length, from north to south, varying from twelve to thirty-six miles, and its breadth from twelve to nearly thirty miles. It includes twenty-three entire townships, and two fractional townships along the State line, the whole amounting to something over eight hundred and forty square miles.

This county probably exhibits as great a variety of soil and surface as any portion of the State of equal extent. Through its western half flow the Desplaines and DuPage rivers, with wide bottoms, subject to annual overflows, and underlaid, at no great depth, through nearly their whole extent, with beds of limestone, which two causes combine to make these bottoms exceedingly fertile, wherever the soil is deep enough to give holding-ground for crops.

The banks of these rivers, with those of the Kankakee, which flows through the southern part of the county, being largely composed of decayed limestone ledges, and banks of limestone gravel, furnish many fine localities for the cultivation of the grape and other fruits, Messrs. J. H. Daniels, R. H. Waterman, and others, are already engaged in grape culture, near Wilmington, with very flattering success.

The eastern part of the county is mostly rolling prairie, with some considerable stretches of small timber in its northern portion, where the high land of this part of the county begins to slope off toward Lake Michigan. The ridges are mainly composed of sand and gravel, which give good drainage to the comparatively thin covering of brown loam, and favors wheat and other small grains, while the intermediate stretches of lower ground possess a heavy black mucky soil, underlaid by clay, and produce heavy crops of corn.

The southwestern corner of the county, below the Kankakee, is a level prairie, being the northern extremity of Grand Prairie, and possesses the usual heavy, rich, black muck, which produces such immense crops of corn. Considerable portions of this, however, are occupied by coal miners, this being the nearest source of supply for the Chicago coal market.

Throughout the valley of the DesPlaines, DuPage and Kankakee rivers, the alluvial deposits constantly remind the observer that this county once bordered the lower end and the outlets of Lake Michigan. The "mounds" along the DesPlaines, which were formerly attributed to the industry of the aboriginal "Mound builders," are evidently the islands and banks of the old western outlet; while the sandy ridges of the Kankakee valley, apparently identical in structure and in timber overgrowth with those now formed and forming on the shores of the present lake, tell us of the former existence of either an eastern outlet, by the way of either Deep creek or Salt creek, (in Indiana,) and the Kankakee, or, perhaps more probably, a lake-like expansion of the Kankakee, before it cut down through the heavy bedded Niagara limestone and the underlying shaly calcareous sandstones of the Cincinnati group, which form the high bluff banks of this river along its course through this county. These sand ridges have been traced on the southern side of the Kankakee as far as the mouth of Yellow river, in Starke county, Indiana, and at frequent intervals on the north side of it. Further remarks upon this subject will be found in the report upon Kankakee county.

Among the alluvial deposits of the DesPlaines valley, Mount Joliet claims especial attention, from the fact that it has been made notorious by those early writers who supposed it to be the work of the "Mound-builders," who preceded the Indians in the occupancy of the country, and also because the bed of clay at its base is now made of considerable economical value in the production of brick. This bed is a light drab homogeneous clay, from seven to eight feet thick, of either river or lake origin, and is overlaid by from twenty to thirty feet of a limestone gravel, formed from the outcrop of Niagara limestone, which is continuous for several miles above this point. This is probably only a remnant of a bed which formerly filled the whole valley, and was cut away again by river action before the waters of Lake Michigan were turned from their ancient outlet.

As subsequent in age to this river and lake alluvium, we may here refer to the large boulders, which are so abundantly distributed over the broad levels which cap the first terrace, in the southwestern part of the county. The majority of them are composed of "green-stone," or "trap," probably from the Lake Superior region, while the remainder furnish representatives of nearly all the varieties of metamorphic rocks. From their position above the black soil, it is evident that they floated to their present position on fields of ice, not long before the river retired to its present lower level. They are especially abundant at points where the surface configuration shows that eddies would be likely to form, which would retain the ice-floes until they had time to melt and drop the burdens of rock which they had brought from more northern regions.

Of the Drift proper, we see but little, since the alluvium covers so large a portion of the surface. The boulder clay, however, with occasionally a patch of conglomerated sand and pebbles, shows along the Kankakee for two or three miles below Wilmington, and the same beds are often met with in deep wells in the eastern part of the county, and also in the northwestern townships above the DuPage.

The gravel bed above the boulder-clay is, at some points, more or less compacted by a ferruginous cement, so as to form quite a solid conglomerate. The most notable instance of this is at "Knowlton Mound," about a mile east of Joliet, along the Cut-off railroad, where huge masses of the conglomerate lie about in every direction, the looser and finer underlying beds having been shipped to Chicago for street improvements. Traces of iron, in the water which leaches through the overlying soil and clay, give to the gravel a cementing quality, so that it packs very finely in the roadway, and, after a few months' use, can hardly be broken up with a pick. C. Knowlton, Esq., of Joliet, the owner of the mound, informs me that between 30,000 and 40,000 yards of this gravel were delivered in Chicago during the season of 1869, at a cost of over $70,000.

The rock formations of the county are confined to the Coal Measures, the Niagara limestone and the Cincinnati group.

Coal Measures.—The rocks of the Coal Measures cover something less than two townships in the southwestern corner of the county. They consist mainly of fine grained sandstones, clay shales and fire-clays, accompanied by one, or, possibly, two seams of coal.

The outcrop enters the county near the mouth of the DesPlaines river, includes a few sections about the junction of the DesPlaines and the Kankakee, passes south of the latter river below the feeder-dam, crosses the center of section 8, the west half of section 17, the northwest corner of section 20, the east halves of sections 19 and 30, the north halves of sections 32 and 33, and the west half of section 34, of township 33 north, range 9 east, and through the west half of section 3, the east half of section 9, the west half of section 16, the east halves of sections 20, 29 and 32, of township 32 north, range 9 east, to the southern line of the county.

Two seams of coal appear to exist in this county, viz. that worked at the Schoonmaker shaft, in section 7 of Wilmington township, and the main seam of all this region, which is worked at all the other mines, and is the equivalent of No. 2 of the general section of the coals of the Illinois valley.*

---

*See Geology of Illinois, vol. iii., p. 5.

The Schoonmaker coal is locally ten and a half feet thick, and at no place in the workings is it less than eight feet thick. So far as known, it is overlaid directly by brown and drab alluvial clays; and, to supply the deficiency of roof rock, the upper layers of the coal are left in place, the workings nowhere much exceeding six feet in hight. The upper and lower benches are of clean cubical coal; while the central portion has a very irregular fracture, and powders readily. As a whole, the coal is impure, containing disseminated pyrite and partings of calcite, and yielding a very large proportion of ash. Certain portions of the bed are quite free from all these objections; but, here as elsewhere, no pains has ever been taken to separate the good from the bad, and the mine has consequently a bad reputation, though what is dug still finds a ready market. The floor of this mine is composed of from four to six inches of fire clay, resting upon a thin bedded, fissile, carbonaceous, micaceous sandstone, which has been penetrated to the depth of four or five feet in the sump.

This seam is evidently the equivalent and continuation of the ten-inch seam of coal, accompanied by from eight to ten feet of coaly shale and shaly sandstone, which outcrops on the bluff of the Kankakee, about one and a half miles northwest of the mine, in the edge of Grundy county. Above the mine, in section 8 of the same township, this seam has been worked in the bed of the river, and is said to be from three to four feet thick, with a floor of a few inches of fire clay resting upon the lowest beds of the Niagara limestone. The coal is here, of course, greatly deteriorated by exposure; but it is considerably used by the neighboring farmers. This was the first coal known in all this region, and has been worked more or less since a very early date in the settlement of the country. At Schoonmaker's ford, on the county line, this seam is recognized in a band of rotton coaly shale at the top of the bluff, and is underlaid by from fifteen to twenty feet of ferruginous and micaceous shaly sandstone, accompanied by concretionary nodules, which sometimes contain fragmentary remains of *Lepidodendron* and other plants. A short distance below the ford, we find this sandstone resting upon a few feet of olive and ash-colored shales, which, in turn, rest upon the shaly limestones of the Cincinnati group. Where this seam has been worked in the bed of the river, four or five feet of blue clay shale, with fossil ferns, have been reported as resting upon it, in some cases; but, below the county line, it is overlaid only by a thin bed of purplish shaly clay, entirely destitute of fossils.

The extent of this bed is supposed to be very limited, as borings made within a half mile of the shaft, on the southward and eastward, have failed to find it or its equivalent, while there is reason to believe that it does not extend far north of the river. The underlying shaly sandstone has been met with in small patches as far north as the southwest quarter of section 21, township 34 north, range 9 east, but unaccompanied by any indications of coal. Along the Des-

Plaines, below this point, the sandstone lies partly upon the bottom beds of the Niagara limestone, partly upon the green shales at the top of the Cincinnati group. It here contains some remains of trees, one of which, forty or fifty feet long, has been mentioned by Schoonmaker as a tree of "black walnut," which in *color* it very much resembles.

Above the feeder dam on the Kankakee, coal is said to have been found in the bed of the river opposite the mouth of Prairie creek; but, at Mr. Mellai's place on the opposite bank, the bluff is composed of dark colored shales, partly sandy, partly calcareous, belonging to the Cincinnati group, between which and the Niagara limestone quarried on the other bank, there is certainly no place for any *regular* deposit of coal.

As I have been unable to connect the foregoing section with any outcrop whose position is known, and in the absence of characteristic fossils, I cannot determine with certainty, its relation to the other Coal Measure rocks of this county; but it probably belongs below them, and its equivalent should be found by boring below the level of the main seam at points further south. However, as the seam is so variable within the small space over which we have recognized it, there would be no certainty, in fact, very little probability, of its yielding any paying quantity of coal at any given locality. I cannot, therefore, encourage the hopes which some persons entertain, of finding another seam of coal, by boring in the bottom of the present workings, while, at the same time, I would not deny the *possibility* of finding such.

On the other hand, as I believe that no borings have been made on the west side of this mine, between it and the strippings southeast of Goose lake, the coal at which latter point unquestionably belongs to the main seam, although its characters are very unusual, I cannot *assert* that this is not also a continuation of the same seam, which owes its irregularities to its position upon the extreme border of the basin.

The southwest corner of this county is full of shafts, varying from twenty to seventy feet in depth, by which the main seam of coal is reached, and from which, hundreds of thousands of tons of coal are annually sent to market.

This seam varies from two feet ten inches to four feet in thickness, and possesses various characters, according to location. Some portions yield a very pure coal, fit for blacksmithing, while others yield a very impure article, containing much pyrite and flakes of calcite. Some parts contain these impurities disseminated in small particles through the whole mass; and in others we find them concentrated in certain benches of the seam, or even compacted into one or more thin bands which can readily be removed in mining. As a whole, this seam yields a good coal for steam purposes.

Lying so near the border of the basin, this seam, as well as the one previously treated of, has suffered, more or less, from local displacement, besides having been deposited upon a surface originally irregular. This has been the principal cause of its irregular thickness, and, to some extent, that of its variable character. Where the bed lies upon a sloping floor, a large part of the impurities, especially the sulphid of iron (pyrite), seems to have settled away by gravity and to have accumulated in the lower portions, leaving the upper part comparatively pure.

This irregularity of bottom prevents any regularity in the depth of shafts, and so prevents any accurate estimate of the dip, the general direction of which is toward the southwest. It also prevents any certainty as to the exact line of outcrop; since, from it, we may reasonably predicate the probable existence of outlying patches, separated from the main bed by portions of barren strata. Such will probably be found, when more borings shall be made beyond what is now accounted the boundary of the coal area. These patches, however, are likely to be small, and would not warrant any great outlay in searching for them, especially while so large a portion of territory known to be underlaid by coal remains undeveloped.

So far as is yet indicated by borings, the outcrop of this is essentially as follows: Entering the county near the northwest corner of section 30, town 33 north, range 9 east, it passes diagonally to the center of the south line of this section; thence to the middle of the east line of the northeast quarter of section 31, and eastward to the same point in section 33; thence diagonally to the center of the north line of the northwest quarter of section 3, township 32; thence southwest to the center of the west line of the same section, and to center of south line of section 4; thence to the southwest corner of section 9, and in nearly the same course to the center of section 20; thence due south into Kankakee county. The last three or four miles of this line are determined with less accuracy than the upper portion, since fewer borings have been made in that part of the county.

To the eastward of this line of outcrop, borers have often been encouraged by finding beds of soft clay shale—"soapstone"—corresponding in general character with that which overlies the coal; but, so far as I can learn, none of those lower beds contain any of the nodules of carbonate of iron, often containing vegetable or animal remains, which characterize ten or fifteen feet of the shale immediately on top of the coal, and, in many cases at least, they probably belong to the underlying Cincinnati group, the Niagara limestone being absent from this part of the county.

The overlying shales are of very variable thickness, and are often accompanied by bands, and occasionally by thick beds of sandstone. I am indebted to

Mr. Andrew Binney, of Braidwood, for the following section of the Eagle shaft, on the southeast quarter of section 8, township 32 north, range 9 east:

	FEET.	IN.
Soil and Drift	22	6
Sandstone,—water-bearing	24	
Clay shale,—"soapstone"	27	6
Coal	2 ft 10 in. to 3	10
Fire clay	7 to 8	
Coarse, porous, water-bearing sandstone	12	
Fire clay	8	
Coarse sandstone	6	
Greenish fire clay	15	

The section below the coal was obtained while boring in search of another seam. I have suspected that the "greenish fire clay," at the foot of the section, may be the green shaly clay of the Cincinnati group, but have, at present, no means of deciding the matter.

From other deep borings in this district, I have been unable to get any accurate measurements. I understand, however, that at Keeversville, on the west half of section 5, in the same township, several openings have found a portion of the main seam, varying from six inches to two feet in thickness, separated from its lower side by from eight to twelve feet of fire clay, and itself still overlaid by fire clay. At Cadysville, in the east half of section 5, Mr. Wm. Hennebury has bored, and reports the seams split into two or three portions, each of workable thickness. A company of miners was preparing to sink a shaft at this spot, in the fall of 1868. I have not been able to learn what success they had.

The soft, shaly sandstones along the Kankakee, above Wilmington, which have been supposed to belong to the Coal Measures, are really part of the Cincinnati group, and will be noticed under that head.

Niagara Limestone.—The Sub-carboniferous and Devonian rocks being entirely wanting in this part of the State, we find the Niagara group appearing next in order. The limestones of this group underlie fully four-fifths of the area of the county, but the outcrops are somewhat limited, in consequence of the great extent of the Alluvial and Drift deposits. It is difficult to form any very accurate estimate of the beds exposed, because the outcrops are so disconnected; but it probably does not much exceed two hundred feet.

I choose to consider as the uppermost beds, those thin-bedded but compact layers which are slightly exposed near the center of the south half and on the west line of section 13, and in the southwest quarter of section 15, township 35 north, range 11 east. The outcrop at these points is inconspicuous, and has never been developed. It could probably be made to yield a sufficient supply for all local uses.

Probably near the same level, possibly a little higher, belong the loose, vescular layers in the bed-rock of the creek, at the north-west corner of section 8, town 34 north, range 11 east. The rock is not such as to invite quarrymen, but a local supply, for fences, wells and underpinning, can be drawn from near the west line of section 19, of this township, and the southeast corner of section 13, in the adjoining township; and more extensive quarrying in the low ground would, undoubtedly, develop beds of fair building stone. At present, this is hauled either from the Jackson quarries, near the center of section 15, township 34 north, range 10 east, or from those at Joliet.

The beds which form the bluffs on both sides of the DesPlaines, at and near Lockport, belong at and below this level. Opposite Lockport, the bluff shows, at intervals, from fifty to sixty feet of these beds, which are mostly thin, and more or less vesicular, containing imperfect impressions of fossils. The upper part of these beds is passed over in going east from Lockport, and the fragments loose in the soil indicate that they lie not far below the surface; but the only outcrop seen is in the bed of a small stream near the southwest corner of section 2, township 36 north, range 11 east. At several points, these beds are used for lime, and yield a very fair article. The lower part of these beds contain several layers of chert nodules, often accompanied by a chalky substance. (Messrs. A. Hyatt and E. Bicknell, of the Peabody Academy of Science, Salem, Mass., have, at my request, examined portions of these cherts, microscopically, but have not, as yet, succeeded in finding any organisms except sponge-spicula.) These flinty layers form a ready means of determining a general equivalence of level, though they extend through a considerable thickness of rock, which varies in amount at different localities. I consider them sufficient, however, to synchronize with these beds those that are quarried extensively in the southeast quarter of section 2 and the northeast quarter of section 11, township 36 north, range 9 east. Here I include, also, the beds quarried to some extent in the southwest quarter of section 26, and the northwest quarter of section 35, township 37 north, range 9 east.

The top of the quarry, in the southeast quarter of section 11 of the last named township, belongs at the bottom of the foregoing beds, while the lower part of it reaches the solid blue quarry rock which lies next below. Some thin beds of this rock have been quarried to a small extent, in the southwest quarter of section 31, township 36 north, range 10 east. Its lower portion underlies the DesPlaines valley, from the county line to below Lockport, and furnishes the quarries so extensively worked between Lockport and Joliet. The Jackson quarries, before mentioned, are at nearly the same level. These beds are also extensively quarried in "Twelve-mile Grove," near the center of section 10, township 33 north, range 11 east, and the lower part of the bed is seen in the bottom of Forked creek, in the southwest corner of section 21 of the same township. The rock of this division is a hard, fine grained, compact limestone, with comparatively few fossils; though some of the beds furnish fine large specimens of *Orthoceras*, *Cyrtoceras*, etc. In these beds, also, we frequently find layers filled with the wood-like markings known as lignilites or stylolites. Through the whole of this division, we find more or less partings of greenish clay, which upon long exposure, ultimately develop seams, even in those beds which, when freshly quarried, appear the most solid. The amount of this material increases rapidly as we approach the base of this group in its southern extension, indicating that the conditions which produced a deposit of from forty to fifty feet of it in the Cincinnati epoch, continued, though with less intensity, long after the introduction of the fauna which characterized the Niagara period.

The bottom division of this group contains beds of very various characters. Near Grinton's mill, the beds are partly cellular, partly quite compact, partly nearly a pure drab limestone, partly a soft buff, impure limestone, in character approaching the underlying beds of the Cincinnati group.

At and below Joliet, they are nearer the upper beds in material, and furnish some fair building stone, but they are still quite cellular, and contain more of the greenish clay partings. They retain this character, the thin layers becoming more compact in structure, but separating more readily, as we pass to the southward of Channahon, and across to the Kankakee. Here, they retain their later character until we pass Wilmington; but, near the southeast corner of the county, they again become more porous and impure. This change of character is noticeable in connection with the fact that, at and near Grinton, these beds rest upon the shaly magnesian limestones of the Cincinnati group, which thin out toward the southwest, and finally disappear entirely, leaving the Niagara beds, from above Wilmington to opposite Channahon, resting directly upon the underlying green shales.

At the mouth of Prairie creek, three miles below Wilmington, one of the lowest beds of this group has furnished large slabs covered with fine specimens of *Pentamerus oblongus*, which is, in New York, characteristic of the Clinton group, but I am unable to distinguish any corresponding division of the rocks in this region. The *Orthis bilobus* occurs in the corresponding beds near Channahon, and *Stromatopora*, and other Niagara corals are not rare in the bottom layers of the quarries east of Wilmington.

As a summary of the rocks of this group, I offer the following general section:

	FEET.
Thin bedded, coarse, rather vesicular beds	75
Irregularly bedded limestone, with bands of chert	40
Blue quarry stone, weathering buff, heavy bedded	50
Thin bedded, compact to porous, parting readily	40

The outline of this group is nearly as follows: Entering the county near the northwest corner of township 35 north, range 9 east, it runs nearly southeast to near the south east corner of section 24, and includes the larger part of section 30 township 35 north, range 10 east; here, it crosses the DesPlaines, and follows down its south bank, on the top of the bluff, as far as to the center of section 29, township 34 north, range 9 east; here, it passes under the shaly sandstone of the Coal Measures for a short distance, and then accompanies their outcrop up the "Cut-off" to the Kankakee, which it follows, with only a small show upon the south bank, to the mouth of Prairie creek; here it bears more to the eastward, and passes around to the north and east of Wilmington, turning south through section 31, township 33 north, range 10 east, and following the north bank of Forked creek to the middle of section 17, township 32 north, range 10 east; here it crosses, and strikes the bank of the Kankakee in section 20, and follows it westward through the county. Forked creek and its cut-off also inclose an island of this group, which occupies considerable portions of sections 7 and 18, township 32 north, range 10east. This group also appears upon the south bank of the river for about a mile below the county line.

The general dip of the beds is toward the northeast, but there are everywhere so great local variations, both in direction and amount, that any attempt to indicate them by figures would be fruitless. This has probably resulted, at least in part, from the softness of the underlying beds.

Cincinnati Group.—The rocks of this group, in Will county, consist of buff shaly argillaceous and magnesian limestones, with pyrite and some chert, a heavy bed of green shaly clay, and blue shaly limestones with some petroleum.

The bottom beds at Grinton's mill probably belong to this group, but, at this locality, the lower beds of the Niagara approach so closely in character to the upper beds of this group, that it is very difficult to mark the division with certainty. One mile down the DuPage, however, in the southwest quarter of section 16, township 35 north, range 9 east, there is an outcrop of undoubted Cincinnati group. The beds here are light buff, porous, magnesian limestones, with bands of chert nodules. A small *Loxonema* in the chert was the only fossil observed. The section exposed is from twelve to fifteen feet thick. Near the center of the north half of section 5, township 34 north, range 9 east, from eight to ten feet of thin-bedded buff limestone with sandy partings, probably corresponding with the lower part of the above section, have been quarried to a small extent in a hill side. A half mile east of this, in the south half of section 33, township 35 north, range 9 east, from eight to ten feet of thin-bedded argillaceous limestone, with many of the common fossils of this group, form the low bank of the DuPage. These beds underlie those before mentioned, and are probably equivalent to the middle of the Rock run section.

At the mouth of Rock run, near the east line of section 35, township 35 north, range 9 east, considerable stone has been quarried for local use. It is a thin-bedded, very argillaceous limestone, originally blue, but weathering first rusty and then light-drab, with bands of chert near the top of the quarry, and more or less pyrite scattered through the whole mass. Fossils are abundant, but rather fragmentary, including *Orthocerata*, various brachiopods, a few trilobites, and some fucoidal markings. The thickness exposed is nearly forty feet.

Near the bridge over the DesPlaines, in the northeast quarter of section 21, township 34 north, range 9 east, we find these beds of limestone thinned out to about ten feet, between the Niagara limestone and the underlying green shale. They here contain an abundance of *Petraia* and *Orthis*, with an occasional *Calymene*, and one or two other forms. No equivalent of these beds has been recognized upon the Kankakee, though it may possibly be represented among the buff limestones of this group, near the southeast corner of the county.

The bed of green shaly clay which forms the middle division of this group in this county, is a perfectly homogeneous, fine-grained clay, with no fossils, and no impurities of any kind so far as observed. Along the DesPlaines, through the east half of township 34 north, range 9 east, this bed is known to be from forty-five to fifty feet in thickness, and it is not less than that on the Kankakee, where it is first observed just above the mouth of Prairie creek, on the north bank, and thence accompanies the outcrop of the overlying Niagara rocks up the river to near the county line, where it dips below the water level. Above Wilmington, it becomes more impure, and somewhat thinner.

Below this bed, along the Kankakee, especially near and on the banks of Horse creek, there is a considerable outcrop of about fifty feet of drab and greenish shaly sandstones, rather irregularly bedded, and showing fucoidal markings. The same beds, of a locally different character, are exposed for a short distance along the south bank of the Kankakee, opposite the mouth of Prairie creek. From near the top of this bed, a boring has been made at Mr. Johnson's place, on section 13, township 32 north, range 10 east, of which the following is the reported section:

		FEET.	IN.
1.	Shaly sandstone	50	
2.	Soft clay shale, ("soapstone")	30	
3.	Flinty sandstone	5	6
4.	Blue "soapstone"	24	6
5.	Hard drab clay shale	6	

The "soapstone" No. 2 of the section, outcrops along the river bank, about two miles above Wilmington, and, from its close resemblance to the blue shale above the main coal seam, has misled many persons into the belief that the coal could be found farther east. It was only after repeated examinations that I became satisfied of its true position.

The "flinty sandstone," No. 3, is probably the representative of the compact fragmentary clinking limestone which shows a much greater thickness at its outcrop near Wilmington. This lower division of the group there consists of light blue shaly limestones, with occasional bands of these compact layers, fitted for underpinnings, but rarely furnishing material suitable for superstructures. Its outcrop is very limited, being confined to the bottoms of the Kankakee, between the mouth of Forked creek and the ford near the north line of section 12, township 32 north, range 9 east, and the banks of Forked creek below the "county road" running east from Wilmington. Over all this outcrop, the beds are crowded with the ordinary fossils of the group, such as *Rhynchonella capax*, *R. hemiplicata*, *Orthis lynx*, *O. subquadrata*, *Leptæna sericea*, *Strophomena alternata*, *Orthocerata*, *Tentaculites*, corals, bryozoa and crinoidal fragments, with occasionally fine fragments of trilobites.

A boring upon the island, at Wilmington, gave the following section:

	FEET.
Blue shaly limestone	15
Hard, gritty rock, in thin layers	15
Dark clay shale, with pockets of petroleum	70

Petroleum is also found filling cavities in the overlying beds of more compact limestone, which outcrop farther up the river, and add probably twenty-five or thirty feet to the foregoing section. These beds also frequently contain cavities lined with very pretty crystals of the "dog tooth spar" variety of calcite. The limestone itself is composed of comminuted shells and crinoids, and yields few fossils in good condition.

Mr. Jason Franklin reports the following as the section found in his "oil-well," in the south half of section 23, township 32 north, range 10 east:

	FEET.
Sandstone	15
Clay shale, with harder bands	115
Yellow and white sandstone	5
Blue sandstone	100
Blue sandstone, with pyrite	38

As no beds of sandstone are found elsewhere to correspond with the lower beds of this section, and as the upper fifteen feet are evidently the rotten beds of magnesian limestone which form the base of the Niagara group in this region, I am disposed to believe that the lower beds are also limestone. If this is true, the one hundred and fifteen feet of "clay shale, with harder bands" will correspond with the two upper divisions of the Cincinnati group, as above given; the one hundred and five feet of "sandstones," the lower division of this group, and the thirty-eight feet of pyritous rock may represent the compact drab limestone, sometimes pyritous, of the Trenton group, the top layers of which are quarried in Saratoga, four miles northeast of Morris, in Grundy county. The whole section, however, is liable to error, having been made by an inexperienced borer. I give it as the only indication, however imperfect, of the underlying beds in this part of the county, with the exception of Mr. Johnson's boring, before given, which did not reach so great a depth.

SUMMARY.

The following is an approximate estimate of the total thickness of rock exposed and explored within the county:

	FEET.
Alluvial and Drift clays and gravels	100 to 150
Coal Measure sandstones and shales	100 " 125
Niagara group limestones	200
Cincinnati group limestones, shales and clays	220 " 260
Trenton group limestones ?	38 ?

Economical Geology.

Among the mineral resources of Will county, the first place is naturally given to

Coal.—Though the outcrop of the Coal Measures covers but a very small part of the area of this county, yet the amount of coal mined therefrom is very large.

NOTE.—During the summer of 1869, an artesian well was sunk at the Penitentiary, near Joliet, and the following section of the bore has been furnished me, through A. J. Matthewson, Esq., of Lockport:

		FEET.
1.	Rubbish	12
2.	Cherty limestone	16
3.	Soft white granular limestone	60
4.	Coarse rock, resembling Niagara limestone	279
5.	Soft shales and clay	110
6.	Clear sharp sand-rock, full of water	50
	Total	527

It is impossible to make this agree with known outcrops, or with the facts ascertained by borings in adjacent counties. Nowhere in this region, if anywhere, is there such a bed as No. 5 lying upon the St. Peters sandstone of No. 6. If Nos. 4 and 5 could be made to exchange places, we might suppose the 279 feet of limestone to represent the lower part of the Cincinnati group and the whole of the Trenton. There is probably error in the record.

Analyses of a few coals from this county were made some years since, and were published in the first volume of these Reports: since, fuller examinations of the territory have shown the great variations in the character of the coal within short distances, a phenomenon which usually accompanies outcrops so near the edge of the basin, it has not been thought best to make any further examinations of this sort. Throwing out the more noticeable impurities, such as the nodules and layers of pyrite or "sulphur," and the occasional bands of slaty clay, the mass of the coal makes a very good article for steam purposes, and some portions furnish a good blacksmithing coal; but no considerable quantity is found that appears suitable for smelting purposes.

Assuming the coal area in this county to be about twenty square miles, and allowing to the seam an average thickness of three feet three inches, the usual rule of estimate would give 66,000,000 tons as the amount accessible within the county.

Building Stone.—The quarries of Joliet and Lockport make no insignificant figure in an estimate of the resources of Will county. The amount of stone accessible here is almost unlimited. Only from twelve to fifteen feet of beds furnishing "dimension stone" are now quarried, as the bottom of this brings the quarrymen down to the water level, and the supply has thus far been so abundant as to make deeper exploration unnecessary. Above the layers which are quarried, there are several feet of beds, now decayed, which were originally of very nearly the same consistency as the lower ones; and when they shall be worked back into the hill beyond the extent of atmospheric influences, will probably be found equally valuable. The stone itself is a very compact, fine grained, clinking, magnesian limestone, but thin seams of greenish clay run irregularly through the whole mass, which, upon long exposure in situations alternately wet and dry, must ultimately cause the most solid layers to split up, especially when they are set up on edge. The separation in the quarry into "ledges" of ten, twenty-four, thirty, and forty inches in thickness, simply results from the presence of somewhat thicker partings of this same greenish shaly clay. It is not probable that this structure will sensibly affect the stone used in building in ordinary situations, except after the lapse of many years; but care should be taken to reject such portions of the layers as come from very near the outcrop.

These beds were formerly described as composed of light buff stone, while the deeper portions of the quarries now furnish "blue stone." The difference results from the difference in amount of oxidation of the small portion of iron disseminated through the whole mass, the change having resulted from atmospheric influence. The same change must ultimately take place in all the "blue stone" which is brought to the surface.

The same beds are now quarried at Twelve-Mile Grove, in the town of Wallingford, and some fine stone is obtained. Distance from railroad communication alone prevents the development of quarries of equal value with those of Joliet.

The Jackson quarries are also in nearly equivalent beds.

The beds of this portion of the Niagara group, where exposed near the surface for some time, yield flagstones of considerable size; but those of the lower portion of the group are more extensively quarried for this purpose, and have, apparently, a rather larger proportion of the shaly partings. This character alone prevents some portions of these lower beds from equaling the higher ones for building purposes.

From the whole extent of the outcrops of this group, small quantities of stone are quarried for fences and wells, and occasionally for buildings; but no other quarries than those above mentioned have assumed any considerable importance as sources of regular supply. The quarry in the southeast corner of section 11, township 37 north, range 9 east, seems to have reached the solid beds below the cherty layers, and is likely to prove valuable; but, at the time of my visit, it had not been fully tested.

The upper division of the Cincinnati group has been quarried to a small extent for local uses, at the mouth of Rock run, between Joliet and Channahon; but the beds are so shaly as to be readily broken up by the weather, and can never furnish a reliable building stone. The limestone of the lower member of the Cincinnati group, occasionally quarried in the bed of the Kankakee, between one and two miles above Wilmington, gives small quantities of a permanent but rather rough and irregular stone. It would probably be worth more for lime, if care were taken to exclude the shaly portions of the beds.

Lime is burned at numerous points in this county, the principal production being from the lower portion of the Niagara group. An impure article is also furnished from the shaly limestones of the Cincinnati group, at the mouth of Forked creek, in Wilmington. Small quantities of hydraulic cement have been burned from a bluish bed near the base of the Niagara group in the south part of Joliet.

Brick.—With such an abundance of building stone, comparatively few brick are used in the county. The production is principally from the brown clay subsoil, which is found distributed throughout the timbered portion of the county, and, to some extent, under the prairie soil. A few brick are also made from the alluvial clay of Mt. Joliet. The fire clays which underlie the main coal seam, in the southwest corner of the county, are made to yield a good article of brick, at Gardner, in the adjoining part of Grundy; but no use has been made of them in Will county.

Pottery.—At Mt. Joliet, large quantities of drain-tile are manufactured from the alluvial clay of the neighborhood. The green, shaly clay, which forms the middle division of the Cincinnati group, in the south part of the county, appears well fitted for potter's use, but I can not learn that any attempts have been made to utilize it. The results of experiments made by the "Mound Company," with the various beds of the neighborhood, are well summarized in the following letter from a son of one of the proprietors, for which I am indebted to our mutual friend, Mr. H. M. Bannister, of the Survey:

PORTLAND, Oct. 6th, 1868.

H. M. BANNISTER, *Assis't Geologist of Illinois.*

DEAR SIR: As regards the Joliet Mound, situated one and a-half miles southwest of the city of Joliet: It is about one-fourth of a mile in length, and two to three hundred feet in width. At its northeast extremity is solid limestone rock, overlaid with a thin stratum of blue clay, above which is about twenty feet of fine gravel, containing a large per centage of cement, and many boulders of various sizes and species. The rock dips toward the southwest, and when it reaches the gravel pit, at or near its extreme end, the gravel bed is forty or fifty feet in thickness in the center, while beneath it is a bed of fine, blue, earthern clay, six feet in thickness, and remarkably free from stones and other impurities, though strongly impregnated with salts and lime, and so solid as to require a sharp pick to excavate it. The top of the bed is stratified and colored with oxide of iron, producing a fine slip or glaze for pottery ware. The lower portion of the bed is solid, and rather an impure clay. The bed dips with the rock, and increases in thickness in the same proportion as the gravel.

Many Indian remains have been exhumed while excavating the gravel, and an old flint-lock pistol was found ten feet in the gravel, while excavating the clay. I have seen toads jump out of the solid bank and hop off.

Under this bed of clay are boulders, gravel and clay, and under that a stronger brown clay, beneath which are strong evidences of the same formation as that above it, and then rock.

One-half mile further to the southwest, is Mount Flat-head, one mile in length, one-quarter in width, and about sixty feet in hight, composed of boulders and gravel, with very little cement and no clay under it. The rock in this mound dips in directly the opposite direction from that in Mount Joliet,

The clay used in the manufacture of tile is from a ridge one-quarter of a mile northwest of the mound, and forming one of the boundaries of the DesPlaines valley. It is a red, earthern clay, formed in cubes, strongly impregnated with iron, and a little lime and some fine gravel mixed with it. (I found the same bed at White Lake, Michigan.) The bed is ten or fifteen feet thick, and is a good, strong, earthern clay, and can be used as a high-fired slip clay, or a lower fire if a flux be mixed with it. Its formation is very irregular, as is all that region. Under it are fine, yellow and blue loams, and under them gravel and boulders and then the rock. Not one hundred feet from this bed is one of brown clay, of great depth and filled with lime pebbles. The internal arrangement of the whole ridge is similar to rolling prairie, and of every species of drift. Two miles below the mound, in a railroad cut, you will find a bed of hard, stratified or shaly clay, brown, red and green, with which we experimented largely, but it was so full of lime and lime-dogs as to be of very little value, although it stands a heavy fire to a certain point, and then suddenly gives way, and in burning checks badly by fire and air.

All down the DesPlaines valley, on either side, are extensive beds of the same material. At Channahon, on Mr. Althower's place, in his low land, is a bed of fine, greasy, blue clay, which is very good for a glazing clay, and not far from it is a bed of white marl. On the Rock Island railroad, near Mokena, is a bed of green clay, and you will find pockets of it in the rock at Lockport.

I know very little of the Goose lake clay, save that they have had great trouble with it. At the coal mines at Morris, is a species of fire clay, but we did not think much of what we tested. On the line of the Alton and St. Louis railroad, between Willow Springs and Athens, you will find white fire sand. There are no valuable clays within sixty miles of Chicago, and not extra brick clays. Yours truly, and in haste.

GEO. D. GOODRICH.

Peat has been found in small patches, in some of the swampy land near the east line of the county, but no beds of any importance have yet been reported.

Copper.—Nuggets of native copper have been found in the Drift of this county, and have caused occasional excitements over the prospect of finding a copper mine. One was picked up at Lineburger's quarry, near Wilmington, where it had fallen upon and partially sunk into the decomposed green, shaly clay of the bottom of the quarry, and "boring for copper" was seriously talked of, but better counsels prevailed.

Iron Ore nodules accompany the shales overlying the coal, but no considerable quantities are accessible. A small bed of bog iron ore was noticed, near the saw mill, near the center of the west line of section 13, town 35 north, range 11 east, but no exploration has been made to ascertain its depth or exact extent. Considerable beds are known to exist in the adjoining parts of Indiana, and all extensive deposits will ultimately become valuable for use, in connection with the more compact and richer ores of Marquette and Missouri.

Water.—Through the eastern part of the county, a constant supply of water is not readily accessible, in consequence of the thickness of the deposits of sand and gravel which overlie the boulder clay and form the high, rolling surface characteristic of this region. A few springs reach the surface in the timber, and some of the prairie ponds retain their water through the year; but, in a dry season, there is often much suffering among cattle. So far as I could learn, no wells have been driven through the boulder clay; below it, an unfailing supply could be reached, though, in some places, the depth would forbid attempts to raise it. The three river valleys are mostly well watered by springs flowing from the outcropping edges of the rock strata. All over the DesPlaines bottoms, wells are readily obtained at a small depth in the rock, the water of the river finding ready passage through the numerous crevices and worn passages which are so characteristic of limestones exposed, in any degree, to water action. The triangle between the DesPlaines and the Kankakee, below the bluffs of the second terrace, which run from opposite Channahon directly toward Wilmington, has comparatively little soil upon the rock, and much of it is entirely destitute of surface water. By penetrating, however, the heavy beds of green, shaly clay, which underlies it, and is here from forty-five to fifty feet thick, an abundant and never-failing supply can be obtained, from the surface of the underlying shaly limestone.

The high ridge of boulder clay and gravel along the western line of the county, above the DesPlaines, has few wells that do not fail in a dry season. On the eastern slope of that ridge, in section 30 of Plainfield township, as I am informed by Rev. Dr. Clark, of that town, Deacon Caton bored sixty-one feet through the boulder clay, and got water just after striking the solid rock. I do not know the level of the surface at that point, but judge, from what I know of the levels elsewhere in that region, that this well must have reached as low as the lake level, and perhaps lower.

In the Eagle shaft, at Braidwood station, the coarse sandstones, which accompany the Coal Measure shales, yield a very large amount of pure water, a four-inch stream flowing constantly from the pumps.

Through the artesian well at Joliet penitentiary, water flows freely from the St. Peters sandstone, which was struck at the depth of four hundred and seventy-seven feet. The following data will be the means of calculating, approximately, the depth of this bed in most parts of the county, assuming that the dip of the sandstone is regular :

	Feet above or below datum.	Depth to sandstone.
Morris—section 4, town. 22 north, range 7 east.........	—56	370
Joliet— " 3, " 35 " " 10 "	—24	477
Chicago— " 9, " 38 " " 14 "	plus 21	834

Morris to Joliet, east 30° north, 21 miles.
" " Chicago, " 35° " 51 "

Levels of points in Will county, above or below "Datum of six feet below the lowest registered water of Lake Michigan," as furnished by the Illinois River Survey, in charge of Gen. J. H. Wilson, U. S. A.:

	FEET.
DesPlaines river (low water) at county line above Lockport....................	plus 12.150
" " " " " Lemont (Cook co.)............................	" 13.795
" " " " " Lockport	—13.540
" " " " below railroad bridge at Joliet......................	—58.657
" " " " mouth of Rock run..............................	—71.640
" " " " under Kankakee feeder aqueduct....................	—85.268
" " " " at junction with Kankakee..........................	—87.809

Bluffs at Lockport, east side, plus 74.09; west side, plus 66.27
" " Lemont, " " " 102.00; " " " 137.20

Kankakee river (low water), east line Grundy co..............................	—83.110
" " " " head of feeder, below State dam......................	—69.588
" " " " " " " above " "	—69.580
" " " " Prairie creek..	—58.498
" " " " under road bridge at Wilmington....................	—51.501
" " " " above rapids " "	—39.112
" " " " east line of Will co................................	—27.698

		FEET.
*North of Momence—Kankakee and Will co. line	plus	128.578
" " " summit, or dividing ridge	"	173.206
" " " Eagle lake	"	147.532
" " " waters of Plum creek	"	125.280
" " " village of Crete	"	154.460
" " " waters of Thorn creek	"	125.830
" " " village of Bloom (Cook co.)—Cut-off railroad	"	108.550
Illinois Central railroad—Village of Monee	"	228.000
" " " Cook and Will co. line	"	180.000
" " " line townships 34 and 33	"	200.000
" " " " Kankakee and Will co's	"	103.000
Chicago, Rock Island and Pacific railroad—Village of Mokena	"	142.000
" " " " " " DuPage river		—80.000
" " " " " " village of Minooka (Grundy co.)	plus	35.000

In the survey of this county, I am especially indebted to the kind assistance of A. J. Mathewson, Esq., of Lockport.

---

*On a rather irregular line, varying from one to two miles, east of west line of township, range 14.

CHAPTER XV.

KANKAKEE AND IROQUOIS COUNTIES.

Kankakee county is bounded, on the north, by Will; on the west, by Grundy and Livingston; on the south, by Ford and Iroquois; and on the east, by Lake and Newton counties, of Indiana. It forms nearly a rectangle of twenty miles from north to south, by about thirty-eight from east to west; but two townships of the northwest corner of this rectangle have been assigned to Will county, thus reducing the area of Kankakee to about 674 square miles.

This area is divided into three unequal portions by the Kankakee and Iroquois rivers, the former of which enters the county near the middle of its eastern side, runs westerly, and thence southwesterly to the mouth of the Iroquois near the center of the southern third of the county, and thence northwest to the southwest corner of Rockville township, whence it passes into Grundy county. From near the center of the south line of the county, the Iroquois flows in an irregular northerly course to its junction with the Kankakee, just below Aroma. The Kankakee is fordable at numerous points below Momence; but above the dam at that place, it is deep, and nearly level for some miles beyond the State line, having a fall of from four to six inches to the mile. From Momence to Rockville, its fall is one hundred and twenty-seven feet, or above five feet to the mile. Throughout this latter part of its course, it has a rock bottom, affording good foundations for dams, whether for utilizing the water power, or for purposes of navigation. With this latter point in view, the United States Government has caused surveys to be made, which have shown that, by the construction of a few dams and locks, this stream can, at comparatively small expense, be made navigable from St. Joseph's county, Indiana, to its junction with the Illinois. The Iroquois is rocky and shallow through all of its course within the limits of this county, but, from the county line, it is deep and still, and is navigable for flat-boats, nearly or quite to the Indiana line.

Along the latter part of the course of the Kankakee, its bottoms are narrow, and rocky bluff-banks are quite frequent, but, above Aroma, the bottoms are much wider, and any rocky banks are of very little hight. Over these bottoms are large deposits of sand; and sand ridges from fifteen to thirty feet high, form, in many places, the boundaries of the bottoms, that is, the banks of the ancient river valley. Similar banks were traced up the valley of the Iroquois, as far as Middleport, in Iroquois county, and are said to form its banks for some miles above the Indiana line. These banks were not carefully examined, for want of time, but I learn that they contain, in many places, numerous shells of *Unio*, *Paludina*, and other forms, identical with those now living in the rivers.

I was formerly inclined to believe that the Kankakee valley was at one time occupied by an outlet of Lake Michigan, which ran from its southern extremity by the valley of either Deep river or Salt creek; but, since I find that the sand ridges are continuous with those which are so largely developed in the upper part of the Kankakee valley, and especially since Dr. E. Andrews, the learned President of the Chicago Academy of Science, assures me, from personal observation, that no connection ever existed by Deep river or Salt creek valley, I am compelled to believe that this was a distinct lake basin, twenty-five or thirty miles wide in its upper part, and of as yet undetermined length The sand ridges, which mark its outlines, have been traced, almost continuously, from the mouth of Waupecan creek, on the south bank of the Illinois, nearly opposite Morris, in Grundy county, to the mouth of Yellow river, in Starke county, Indiana. I learn from Mr. A. J. Matthewson, of Lockport, who has explored much of the Kankakee valley, that they continue over the divide, and connect with the sand ridges of the Wabash valley. This, however, unless the connecting portions are *proved* to have been deposited by water in their present position, would not prove the connection of the waters of the two basins, since the wind often raises, upon lake shores, accumulations of sand to a considerable hight above the water level, as at Michigan City, where an elevation of this sort has attained a hight of one hundred and seventy-six feet above the lake; and these connecting portions may have had that origin.

Along the Louisville, New Albany and Chicago railroad, the highest sand beds on the south side of the valley were found at forty-five miles from Michigan City, at an elevation of twenty-five feet above the Kankakee, and one hundred and four feet above Lake Michigan. On the north side of the valley, the highest beds were found at Hog creek, twenty-one miles from Lake Michigan, at about the same level. Above this level, at both points, the gravel beds of the Drift come to the surface, covered only by the soil. Through the eastern part of Iroquois county, Illinois, and the central part of Benton county, Indiana, there is said to be a stream of boulders, two miles wide, having a general northwest and southeast direction. Although these must have been dropped from floating ice, at a time when all this country was under water, so that we cannot argue directly from their position with regard to the form of the land at a later period, yet we may fairly infer that whatever channel then existed probably had the aforesaid direction; and, since no such depression appears to exist, or to have existed toward the southwest, it probably did exist to the eastward, and it is not impossible that old Lake Kankakee had its outlet by the Wabash, before its waters began to cut down the rocky barrier through which they have since excavated the deep valley from Aroma to Wilmington.

Though the sand ridges have not been traced to their limit on the upper Iroquois, yet, as the bed of the river at Renssalaer, only sixteen miles from the southernmost sand bed on the L., N. A. & C. R. R., is said to be only thirteen feet higher than the top of that bank, it is evident that the old lake must have nearly surrounded the high land of the southeastern part of Kankakee county, and the northwestern part of Iroquois. The elevation of this peninsula is known to me at only one point,* namely, at Morocco, Newton county, Indiana, which Owen states to be one hundred and eighty feet above the bed of the Kankakee at Momence.

The peninsula between old Lake Kankakee and Lake Michigan varies from ten to twenty-five miles in width, and is seventy or eighty miles long. The lowest *measured* point is near Eagle lake, in Will county, Illinois, where Col. Worrall's surveying party found an elevation of one hundred and seventy-three feet above the established "datum" of "six feet below the lowest registered water of Lake Michigan." Monee, a few miles west of this point, is two hundred and twenty-eight feet above "datum," by railroad survey. It is probable that a much lower point exists upon the "divide," somewhere near Deep river or Salt creek, in Lake county, Indiana. A large sand ridge forms the north shore of Eagle lake, at an elevation of one hundred and forty-eight feet above "datum;" but this is probably local, and not directly connected with the ridges of the river valley.

Much of all these sand accumulations is nearly pure quartz grain, partly worn and rounded, as if by long wear and travel; while parts are evidently merely the disintegrated sandstones of the Coal Measures, not much changed by friction.

For further details of elevations and distances, I must refer to the map accompanying this report, for which the survey is originally and principally indebted to the liberality of Mr. A. J. Mathewson, chief engineer of the Illinois and Michigan canal; though many levels have also been added from data kindly furnished by Gen. J. H. Wilson, chief of the Illinois River Survey, and

---

*The Chicago and Danville Railroad crosses this promontory, a short distance west of the State line; but applications for the profile of that road have been unsuccessful.

Dr. E. Andrews, of Chicago, as well as from the publications of Profs. Richard Owen* and R. T. Brown†, and from reports of railroad surveys.

I have been unable to obtain any satisfactory information regarding the character and levels of the country between South Bend and Lake Erie. It seems highly probable that when that lake stood at the level indicated by the highest terrace upon its ancient shores, not far from two hundred and fifty feet above its present level (say eight hundred and fifteen feet above the ocean), it should have had an outlet toward the west; and this must have been either the Kankakee or the Wabash.

The sloughs which lie between the sand ridges of the old valley are filled with soft black muck, which is just the material needed to make these sandy portions exceedingly productive; when drained of the surplus water, they are themselves unsurpassed as corn-land. In their present condition, they would appear to be just the places for the culture of cranberries for the Chicago market.

Upon the bottom of Beaver lake, just east of the State line, since it has been partially drained, skeletons of *Mastodon* and *Bootherium* have been found by Dr. H. M. Keyser, of Momence, and others; and it is not improbable that remains of these animals will also be found within the limits of Kankakee county.

Drift Formation.—The drier portions of the county, out of the river valleys, are mostly high, rolling prairie, with a few small groves, which shows but a slight covering of soil and thin clay subsoil above the gravel beds of the Drift. At a moderate depth we find everywhere, with few exceptions, the tough, blue "boulder-clay," which usually has, in this region, a thickness of over one hundred feet.

Whether there was or not an outlet from the south end of Lake Michigan, after the close of the Drift period, there certainly was one at that point before the Drift was deposited. This valley, including that of Lake Michigan, *may* have been excavated by a glacier; but of this we cannot be certain, without a more extended examination of its bottom than will probably ever be possible. The depth of this channel, in its northern part, is unknown; its western bank is seen on the Kankakee, just above Momence, where the rock suddenly breaks off, and probes forced to considerable depths found no solid bottom. These facts were ascertained in 1867, by Col. James Worrall, then of the Illinois River Survey, now of Harrisburg, Pa., who also informs me that the same "shoulder" of rock is found upon the Calumet, nearly due north from Momence. In this part of its course, passing through very solid rocks, the channel is rather narrow, rock having been found upon its east side and south of the Kankakee, within seven miles of Momence; the exact location of its eastern bank is as yet unknown. From this point, the course of the channel is not certain; but it *probably* keeps near the State line until it nearly or quite reaches the valley of the Iroquois, then runs westerly to the valley of Spring creek, having a depth of one hundred and sixty feet near Sheldon (as reported by H. S. Wing, Esq., of Kankakee City), and then turns south with a depth of two hundred and sixty-eight feet between Onarga and Gilman, of "over four hundred feet" between Onarga and Spring Creek Station, and of "over three hundred feet" between Paxton and Rantoul, as reported by John Faulds, Esq., of Catlin, Vermilion county. As the western bank was found at Chatsworth, Livingston county, with its top eighty-eight feet, and its bottom two hundred feet below the surface, thus giving a width of fifteen miles or more, it is evident that the softer materials of the Devonian, Sub-carboniferous, and Coal Measure shales and sandstones have afforded less resistance to the denuding agent than the solid Silurian limestones, which confined it to less than seven miles at Momence. Champaign and Onarga, in Champaign county, are located over this old channel, and from one hundred and seventy-five to two hundred and twenty-five feet above its floor; but are probably near its eastern border. Here and at Chatsworth we find, among the Drift beds, a single layer of old mucky soil, with leaves and trunks of trees. At Bloomington, in McLean county, the channel is two hundred and fifty feet deep, and the beds which fill it include two beds of old soil, which I am inclined to accept as indications that this point is near the middle of the old valley, or at least near it principal channel. The route west of Bloomington is unknown.

---

*Geology of Indiana, 1859–60, pp. 201–220.

†Proceedings of the Wabash Academy of Science, Indianapolis, 1855, p. 16.

As the bluffs which bound the DuPage valley, upon the west, are composed entirely of Drift gravel and clay, with a rock foundation nearly on a level with the rock at the head of the Illinois, or about ninety feet below the present level of the lake, while there is an elevated rock island reaching from there to Momence, it is not impossible that, in that region, also, there was at this same period some outlet for the contents of the basin of Lake Michigan; but no deep, strongly-marked channel is there indicated.

Rock Formations.

Though great quantities of fragments of black shale, with not infrequent rounded lumps of coal, are found in the Alluvial and Drift deposits, and continually excite the imaginations of persons ignorant of geology, no beds of either coal or black shale exist within the county, except on its extreme western border. These fragments are either the remnants of beds which formerly existed here, or, more probably, are remains of the beds which formerly connected the northeastern portion of the Illinois coal field with that of Central Michigan, and have drifted hither from the east and north. Much of the black shale, however, probably came from the outcrop of the Devonian (or Sub-carboniferous ?) bed of that material which outcrops so widely through Northern Indiana.

Coal Measures.—As already indicated, the Coal Measures are confined to the extreme western portion of the county. Their eastern boundary enters the county from the north near the center of section 5, township 31 north, range 9 east, runs due south nearly three miles, then bears a little westward, and near the center of the west line of township 30 north, passes into Livingston county. Explorations have not yet been made to such an extent as to indicate more exactly the southern part of this line; but its general correctness has been proved, since its location, by finding that its continuation southward passes directly across the known edge of the field, at Chatsworth, in Livingston county. Along the northern part of the line, numerous borings have been made, and a few shafts sunk. The only ones now furnishing coal are, Hook's, and Gamble's shafts, in section 8, and Conklin's shaft, in section 19, of township 31 north, range 9 east. Hook's shaft is sixty-three feet deep to the coal, with the following section:

		FEET.	IN.
1.	Soil and sandy loam	4	
2.	Brownish clay, with cobble-stones	4	
3.	Blue boulder clay	30	
4.	Bluish clay shales	25	
5.	Coal	2	10
6.	Fire clay	2	
7.	Sandstone	6	

At Gamble's shaft, which is a little shallower, Nos. 2 and 3 of the foregoing section are wanting; and the shales of No. 4 continue up to the sandy subsoil. All of these mines find the coal of pretty uniform thickness, and furnish a good clean coal, well fitted for domestic use and for steam fuel. Their product is all delivered to wagons, for the local supply of the country to the east and southeast of the mines; and the extent of the coal field in this county is so small as to render it doubtful whether a railroad will ever be so built as to give them outlet to a larger market.

The seam is the continuation of that so largely mined about Morris, in Grundy county, and in the lower corner of Will county, namely, "No. 2," of the Illinois valley section. As in the adjoining part of the field, the limit of the seam is quite irregular, the numerous borings having shown that, at some points, currents have washed away the coal, so as leave deep depressions in its outline; and at others, projecting and even isolated patches of the seam are found outside of the general boundary. In the latter case, the seam is sometimes found of full thickness, but without a roof, while in others, only a streak of coaly matter is left.

The extent of the beds of the Coal Measures, below this seam, is unknown. They here rest directly upon the greenish, sandy shales of the Cincinnati group, which, to the uneducated eye, are not readily distinguishable from the bluish drab, sometimes sandy, shales of the Coal Measures.

Niagara Limestone.—No Sub-carboniferous or Devonian beds are known to exist in Kankakee county. It is, of course, possible, that such may remain in place, under the high country of the southeastern corner of the county, but their existence is in no way indicated, and is altogether improbable.

The highest Silurian beds exposed are impure earthy limestones which outcrop along the Iroquois, from Sugar Island, at the county line, nearly to its junction with the Kankakee. The outcrop covers so much space that it would be difficult to make any exact measurement of the thickness of these irregularly bedded strata. I estimated them at from fifty to sixty feet. They have mostly a moderate dip to the southward. Some of the layers have been quarried, in the small way, for local use; and many of them appear well fitted for making hydraulic lime.

These beds apparently correspond in position with the Leclaire limestones, forming the top of the Niagara group; there is no marked separation from the lower beds. A few indistinct plant markings were the only fossils found.

Apparently belonging between these beds and those which outcrop near the mouth of the Iroquois, though on that stream no equivalent strata were seen, are the layers which are quarried at Momence. Here, we find from fifteen to eighteen feet of light gray and drab, impure, argillaceous limestone, the upper half of which contains great numbers of concretions of chert and silicified corals; but the lower half makes a fine building and monumental stone, and is largely quarried in the bed of the river. There are also exposed, just above town, a few feet of light buff, very vesicular, magnesian limestone, full of casts of fossils, which is burned for lime. This apparently belongs beneath the quarry-stone. Among the fossils of this bed were observed *Pentamerus*, *Knightii*, *Bumastes*, *Platyostoma*, *Favosites*, *Cystiphyllum*, and fragments of undetermined crinoids.

Along the river, between Momence and Aroma, a small amount of thin-bedded limestone crops out, but presents no opportunity for measurement. Both at Aroma, and for a short distance up the Iroquois, we find from ten to twenty feet of thin, roughly-bedded, pretty compact, light drab and buff limestone, occasionally cherty, and full of the striated marks of pressure and slipping, which are called *stylolites*. These are locally used for building, though not at all a handsome material. No fossils were obtained here, though they probably occur.

In descending the river, the next outcrop seen is at Kankakee City, where, beneath the bridge, twelve or fifteen feet of thin-bedded, light buff, vesicular limestones ara exposed, which are sometimes quarried for the linings of wells, for foundations, or for road-material. At the foot of Court street, large flags are quarried, with small quantities of thicker stone, from an outcrop of thin-bedded, compact to vesicular, bluish-gray limestones, with partings of greenish clay. The surfaces of these layers often show crinoidal fragments, and occasionally present small crystals or fragments of pyrite. The same beds continue up Soldier creek, and are largely quarried, above the Wilmington road, where the greater amount of covering has prevented the disintegration of the clay-layers, so that the beds appear to be more solid. At this point, a slight southerly dip is apparent. The broad floor of the quarry is strongly marked by a double system of joints, the best developed of which bears by compass due northwest and southeast; the other set is not regular. The same beds present a nearly continuous outcrop down the river, through section 24, township 31 north, range 11 east, and are underlaid, in section 23, by a few feet of cellular limestone, containing casts of crinoids and other fossils, which is locally used for fences. In section 16, we pass down to very compact, though rather thin-bedded limestone, every way fitted for building purposes, for which it is occasionally used. These beds apparently correspond with those quarried at Joliet, in Will county. The same beds are known to exist, at slight depths below the surface, over much of the southern part of this township, and have been opened for local use at two or three points. They are also worked in a small quarry on the west side of section 7, township 30 north, range 11 east (the fractional township), where from eight to ten feet of valuable stone have been opened in the prairie. A fine specimen of *Spirifer crispus* was the only fossil seen here.

Apparently near this level, though possibly a little above it, at Manteno, a small quarry has been opened in an outcrop of thinly and irregularly bedded limestone, which is said to be easily broken up by the frost. It contains many cavities lined with calcite, and a few Orthocerata are occasionally met with.

In descending the river, below the quarries, in section 16, we find the beds becoming thinner and more vesicular, and finally passing gradually into more impure and strongly ferruginous layers, and decomposing readily. It is this feature which has made the valley broader and the slopes of the banks more gentle in this locality.

Cincinnati Group.—Just at the county-line, we pass below the Niagara group, and find about ten feet of the sandy calcareous shales of the Cincinnati group exposed above low-water mark. This is the only *outcrop* of rocks of this group within the county, but the two ranges of townships, west of this point, are almost entirely underlaid by them at slight depths. The prairie surface gives no opportunity of determining the exact outlines of the group; but it is evident that the Coal Measures occupy but a narrow strip of the western side of range 9, and the Niagara limestone a probably still narrower one on the east side of range 10.

A boring in Otto township, five and a half miles south of Kankakee City, and eighty rods west of the railroad, started above the top of the highest beds seen on the Iroquois; and the following section of it was reported to me by Mr. H. A. Williamson, of Kankakee City, who superintended the boring, after it had reached the depth of two hundred and eighty-seven feet:

		FEET.
1.	Gravel and clay	47
2.	Clouded solid stone—"not limestone"	388
3.	Shale, with limestone bands and flints	75
4.	Impure limestone, slacked but little	40
5.	Nearly black, slightly gritty shales	15
6.	Shale, with limestone bands and "flints"	83
7.	Pyrite	1½
8.	White shaly limestone	1½
	Total	651

The three hundred and eighty-eight feet of "clouded solid stone," undoubtedly includes all the limestones, pure and impure, of the Niagara group. The impression that it was "not limestone," arose from the fact that certain specimens, when burned, did not slack. No. 3, with its "flints," may possibly belong to the Niagara; but I am more inclined to account it the top of the Cincinnati group, and to suppose that the "flints" of both it and No. 6, are merely thin layers of compact clinking limestone, sometimes pyritous, such as are frequently called flints by borers and quarrymen, although they contain no noticeable amount of silica. Nos. 7 and 8 apparently represent the top of the Trenton limestone. If that bed has here the thickness of two hundred feet, which is usual in this part of the State, the top of the water-bearing St. Peters sandstone would be reached at eight hundred and fifty-one feet, about one hundred feet nearer the surface than it would be, if the dip observed in Grundy and Will counties was continued to this place.

Economical Geology.

The local supply of all especially valuable minerals is small; and the county must rely for wealth, chiefly upon its agricultural and manufacturing capacities. Aside from the sandy ridges of its river bottoms, its soil is fertile and already produces large crops. But much of the surface is yet uncultivated, and, as elsewhere in fertile countries, the abundance of rich land leads to wasteful farming, which, before many years, must inevitably lead to the production of "old fields," the characteristic result of such farming in the older States. The remedy, of course, lies in thorough manuring, which is, and always will be neglected by those who are ambitious to have the *largest* farms, without regard to the rate of production. The abundant marshes or sloughs, often underlaid by deposits of shell marl, furnish the best of material for rendering the sand ridges fertile.

The water power of the Kankakee is partially utilized by four or five dams and mills; but not a tithe of it is thus employed, though it might be made the source of immense wealth.

Coal exists in sufficient quantities for domestic use, though, even for this, it must be hauled many miles; but it can hardly be profitably used in extensive operations until a railroad shall bring it directly from a larger coal field near at hand. If the east and west road through the county, so long talked of, should be built, an abundant supply of coal would be brought from Grundy and LaSalle counties; otherwise, the reliance must be upon Vermilion county and the Indiana field, whence coal will soon be delivered in the eastern part of the county by the new Chicago, Danville and Terra Haute railroad. The Danville coal is now brought to Kankakee City, *via* the Great Western and Illinois Central roads; but the route is so circuitous that freights make a very heavy addition to the cost. Possibly, the coal recently discovered in Iroquois county may prove sufficiently abundant to be the best source of supply for Kankakee county.

Iron.—Bog ore is known to exist in small quantities in some of the sloughs near the State line. If larger beds can be found within easy reach of the new railroad, there seems to be no reason why Momence should not speedily have an iron furnace, supplied with bog ore from its own neighborhood, with richer ores from Lake Superior, *via* Chicago, with "block" coal direct from the Wabash, and a blast driven by the water-power of the Kankakee. If this be undertaken, it would be well to examine more thoroughly the beds of

Peat, which are known to exist near that place, though now supposed to be of small extent.

Building Stone is quarried at many points in the county. The best rock seen is in the southwest corner of Limestone township, in section 16, of that township, and in the river bed at Momence. The quarries in section 16, of limestone, should be more largely developed, and made to supply stone to all the neighboring country. If the Kankakee were rendered navigable, this might be made a very profitable business, and would pay well even as it is. The rock quarried at Kankakee City is very objectionable on account of the abundance of shaly partings which must ultimately cause the destruction of buildings now erected at so great expense. It would be much wiser for builders of any large structure, especially of those of so extensive and elegant a character as the Methodist church in that city, to pay enough more to cover the expense of hauling good stone five miles, than to use at less expense, a material which will insure the ultimate destruction of the buildings by weathering at no very distant day.

Water.—Artesian wells can probably be obtained anywhere in the county, at a depth nowhere exceeding twelve hundred feet; and it is probable that a permanent supply could be had at nine hundred feet in the western part of the county. The water from the St. Peters sandstone has, in some cases, been found quite saline; but in such cases a purer water can generally be reached by boring into the underlying Calciferous sandstone, and tubing out the upper flow. No artesian wells have yet been obtained in this county, the only deep boring, the "oil well," south of Kankakee City, having stopped at the top of the Trenton limestone. The Drift beds which supply the numerous flowing wells of the south part of Iroquois county, apparently do not exist north of the east and west portion of the Iroquois river valley.

Iroquois county is bounded on the north by Kankakee county; on the west, by Livingston and Ford; on the south, by Ford and Vermilion counties; and on the east by Indiana. It contains eleven hundred and fifty-six square miles, being thirty-four miles square. Of this area, far the larger part is gently rolling prairie. The northeastern quarter is separated from the rest of the county by the Iroquois river, which, entering the county from Indiana, a little north of the center of its east line, flows in a general west course to near the middle of the county, and thence nearly due north into Kankakee county. This stream is quite sluggish, and navigable for flat-boats from the northern county-line up to Middleport; above this point, it is smaller and more broken. Its principal branches are Sugar creek, from the southeastern part of the county, and Spring creek, from the southwestern. All these streams have considerable bottoms, but those of the main Iroquois are especially interesting, on account of their connection with the subject of the old Lake Kankakee. All along this valley, and for considerable distances from the present river bottoms, we find the extensive accumulations of sand which mark the bottom and shores of the old river valley. These beds have not been traced along the upper part of the river, so as to ascertain whether or not they are continuous with those of the upper Kankakee, as has been suspected; but the lower portion of the valley was certainly filled by a broad arm of the expanded channel through which the waters of Lake Kankakee passed to the narrower outlet below. In my report upon Kankakee county, I have expressed the opinion that Lake Erie may possibly have, at one time, poured out its waters in this

---

NOTE.—The map referred to on page 228 has not been published for the lack of means to defray the expense of engraving. The most essential parts of it will, however, be transferred on to the State map, now in process of construction, to accompany the final volume of these reports. A. H. W.

direction; but further consideration of the summit-levels of the Wabash has shown that that stream would have given exit to the waters of Lake Erie at all times when its elevation would have approached that of Lake Kankakee.

The sands of these old river or estuary bottoms, are mostly quite pure silex, and blown about by the winds. Judging from the material, it would seem probable that at least the larger part of them originated from the disintegration of the sandstones of the base of the Coal Measures, which formerly covered the larger part, if not the whole, of this county, together with an extensive region on the upper Iroquois. They therefore have little fertility, except what is due to the small quantity of river-silt deposited with them, and the debris of the small amount of vegetation which has thus far grown upon them. They are in some places entirely barren; in others, they are covered by a thin growth of oaks and hickories. The present river bottoms are of course well covered with a great variety of timber, being very fertile.

The remainder of the county is rich, rolling prairie, covered with the characteristic deep, black, mucky soil which produces such heavy growths of all sorts of vegetables. This is based upon generally thin clay beds of the "Loess," and this upon the sands, gravels, and heavy boulder-clay of the Drift period, which latter bed is, in at least one case, one hundred and sixty feet thick. In a well sunk at Sheldon, the gravel above the boulder-clay was found compacted into a coarse sandstone. At a shaft and boring made in 1865, by Mr. John Faulds, of Vermilion county, between Onarga and Gilman, the following section of these surface deposits was obtained:

	FEET.
Blue and red clay	98
Sand and soft sediment	140
Hard pan	10
Hard stony clay	20
Total	268

At this depth limestone was encountered, and the boring stopped. This may have been only a boulder, but was more probably a solid bed of the Niagara group. A boring made in 1866, between Onarga and Spring creek, is said to have reached a depth of four hundred feet without encountering any solid rock. These and other borings in this region have indicated the existence of an old channel running through the county, which is now entirely filled with the Drift deposits. Examinations in adjoining counties have shown that this is the continuation of the valley now filled by Lake Michigan. Its course is southward from the southern extremity of the lake, trending a little westwardly (though still passing to the eastward of Momence, in Kankakee county), until near the northern line of Iroquois, where it bends more strongly to the westward, and passes on to the southwest corner of the county, with its eastern border near the Spring creek valley east of Onarga, and its western at Chatsworth, in Livingston county. Passing on to the southward and westward, Urbana was within its limits, though probably near its eastern border; and Bloomington appears to have been near its center. Further westward, its location has not been determined. This valley was doubtless first excavated by the glacier which dug out the basin of Lake Michigan; and, as this gradually melted and retired, the material of the "terminal moraine" partially filled the channel, while the river formed from the melting ice, still occupied a part of it. The partially-filled bottom, as the glacier retired to Lake Michigan and beyond, became overgrown with vegetation, the remnants of which we find both in distinct beds, such as have been encountered in boring and shafting at Chatsworth, Urbana and Bloomington, and in the sand and gravel beds which afterward accumulated and filled the valley.

Rock Formations.

No outcrop of rock is known within the county, and we are obliged to rely wholly upon bores and shafts for our knowledge of the underlying beds. The southeastern part of the county is probably underlaid by Coal Measure rocks; but the only point at which this is *known* to be the case, is between Gilman and Watseka, where coal is said to have been found recently at a depth of one hundred and five feet. Reported thickness of seam, eight feet. No details known, at the present writing.

Limestone was reported as existing on the bank of the Iroquois, in section 14, township 27 north, range 13 west, but no outcrop was found; and all evidence favors the supposition that loose fragments found there were remnants of loads of rocks formerly brought in flat-boats from Sugar Island just below the county line, in Kankakee county. These rocks are the uppermost beds of the Silurian, and may be referred to either the Onondaga Salt group, or the top of the Niagara group.

A boring at Onarga encountered its first rock at about three hundred feet in a bed of calcareous shale, which should probably be referred to the upper part of the Cincinnati group, the overlying Niagara and Coal Measure rocks having been removed from their original position here, during the excavation of the glacier valley.

It is not improbable that some thin continuations of the Devonian and Subcarboniferous rocks of Indiana might be found in place, between the Niagara limestone and the Coal Measures, in the eastern part of the county; but it is not probable that they reach to the western portion of it.

Economical Geology.

It is probable that enough coal will be found in the southern part of the county to become largely an article of export, as well as to supply the local demand. From the position in the Measures which the seams here to be found probably occupy, it is not improbable that they may furnish the free-burning "block" coal so much sought for, for furnace use. But of this, nothing is known yet.

Limestone for building, though not of the most durable variety, can be obtained in any quantity along the lower course of the Iroquois, in Kankakee county, and can be brought in flat-boats to the center of the county. Some ef the same beds will yield a good article of hydraulic lime. A strong building lime can be obtained at Momence, and brought into the county very cheaply by the new Chicago and Danville railroad.

The river bottoms are, of course, well supplied with water; and the prairie portions of the southern half of the county, besides getting moderate supplies by the shallow wells in the subsoil, also obtain unlimited quantities of flowing water by forcing "drive wells," or sinking borings from thirty to sixty feet into the sand or gravel beds which occur in the top of the boulder clay. The occurrence of artesian water at so small a depth, and espcoially in unconsolidated deposits, is very uncommon, though not unknown elsewhere. The cause of the phenomenon is a little uncertain. I was at first inclined to suppose that the water supply came from the higher land of Central Indiana, north of the Wabash; but have concluded that that position is untenable. The only explanation which has proved entirely satisfactory to me, is that which refers the source of the water to the St. Peters sandstone, which supplies so many artesian wells in LaSalle, Grundy, Will and Cook counties. Following the line of the anticlinal axis, which runs south 33° east from LaSalle, we find that it passes very near Urbana, at which place deep borings in the materials which fill the old valley, before described, have found at the bottom a pure white sand, closely resembling that into which the St. Peters disintegrates at its outcrop. This sand, and others in contact with it, are so abundantly filled with water in all this region, as to have defied all efforts to sink shafts through it; and it is natural to refer the water to the artesian supply of the St. Peters. If the boulder clay were continuous over the whole region, it would not be likely to allow this water to ascend and escape, except from the edges of the stratum; but, as the Lake Michigan glacier must have continued to occupy this valley after the disappearance of the universal glacier which covered the whole country, and deposited the boulder clay over the general surface, its later deposits, though of the same material, were not continuous with the earlier ones; and it is through the beds formed along the slopes of the valley that the water probably finds means to escape to a higher level. It is only the topmost layers of the boulder clay and those of the overlying clays of the Loess which prevent its escape everywhere to the surface.

Many persons have been inclined to suppose this to be "mineral water," or "poisonous," because where the surplus overflow has been allowed to run through orchards, it has killed the trees. But this was only in consequence of their being *suffocated*, by the water preventing the access of air to their roots. Care should be taken, in sinking these wells, to select points where the surplus water can escape directly to the channels of natural drainage.

The area within which these wells have been successfully sunk is about fifteen miles from north to south, and about thirty-seven from east to west, including a small part of Ford county, as indicated upon the map. At many points outside of this area, the water comes within a few feet of the surface, so as to be pumped out with the utmost ease.

For information concerning this county, I am especially indebted to Edward Rumley, Esq., of Onarga, and H. S. Wing, Esq., of Kankakee City.

CHAPTER XVI.

VERMILION COUNTY.

This county lies on the eastern border of the State, about midway of its length; and is bounded on the north by Iroquois county; on the west, by Ford and Champaign counties; on the south, by Edgar county; and on the east, by Warren and Vermilion counties, of Indiana. It is forty-two miles long, and about twenty-one miles wide, giving an area of about eight hundred and eighty square miles.

The surface of the county presents considerable variety. The northern and southern portions are high rolling prairies, the eastern arms of Grand Prairie, more or less broken by the sloughs and small streams which gather from their surface the main supply of the water which fills the Big and Little Vermilion rivers. Through its center, Salt Fork, which drains a considerable portion of Champaign county, runs in a general easterly direction, until, by its union with Middle and North Forks, it becomes the Big Vermilion, and, near Danville, turns southeastwardly to join the Wabash below Eugene, Indiana. In its entire length within this county, it runs through a belt of timber varying from two to four miles in width. Through the western third of the county, the Little Vermilion is little more than a prairie drain; but becomes of more importance in the lower part of its course, where it is lined with from one to three miles of timber. Both Middle and North Forks have considerable timber along their banks for ten or twelve miles above their junctions with Salt Fork, but only scattering groves farther up. Below the points where they enter the timber, all of these streams have high bluffy banks, with noticeably wider bottoms where they have cut through the softer beds of rock, and narrower ones where they have encountered the harder sandstones. The prairies have a dense, black mucky soil of variable depth, underlaid in most cases by a tough, brown clay subsoil. Along the streams the soil, and in many places, the subsoil, has been removed by drainage, and the underlying more porous clays and gravels have allowed of a heavy growth of timber. Upon the higher grounds, this consists principally of white and black oak and hickories, with only a small proportion, though a considerable variety, of other species. The bottoms support a dense growth of oaks, white and black walnut, mulberry, elm, hackberry, etc., with not unfrequent groves of sugar-maple.

Alluvium.—The alluvial deposits of the bottoms, composed of the broken-up materials of all the older beds which have been worn away in the excavation of the valleys, together with the portions which are continually brought down by the small tributaries, cover considerable surfaces, but have nowhere accumulated to any great depth.

Loess.—The marly and sandy clays of the Loess, a lake deposit made before the formation of the present soil, are not very thickly developed in this county, though they include the brown clay subsoil which underlies almost the entire surface. The only shell-bearing clay observed, though it is doubtless common in the prairie sloughs, is about two miles southeast of Fairmount. The black soil is here from one to two feet thick, and is underlaid by a light brown, tenacious clay, filled with the calcareous shells of *Lymnea*, *Physa*, *Planorbis*, *Sphærium*, etc. In some portions, these have decomposed, and we have white, marly lumps and streaks which are characteristic of beds of this formation. At this locality, the partially decayed skeleton of a Mastodon was found, in September, 1868. The bones were lying partly upon, partly imbedded in, this marly clay, the tip of one of the tusks being within thirteen inches of the surface. The slough had been mostly drained, of late years, the air had permeated the bed and pretty thoroughly decayed the bones, which were doubtless in good preservation so long as they were constantly covered with water. The parts were promiscuously mingled, showing that the animal had not been left to decay undisturbed. Marks of gnawing upon a few of the bones, give reason to suppose that the water in which the animal lay was so shallow as to give access to wolves or other carniverous animals. The fragments are now in the possession of the Chicago Academy of Science.

I am informed that, in the early settlement of the county, the bones of these animals were quite common in the sloughs of this region, and even at the present day the discovery of isolated fragments is no rare occurrence. It seems probable that a little careful searching, in such localities, would secure some still perfect skeletons. It is evident that these enormous animals roamed in considerable numbers over the prairies at no very remote period.

These beds of Loess are everywhere underlaid by the

Boulder Drift.—The deposits of this age form extensive beds, in the northern part of this county. They have been penetrated to the depth of one hundred and fifty feet, near the north line of the county, where they compose the dividing ridge between the waters of the Big Vermilion and those of the Iroquois. Along both sides of the Middle and North forks of the Big Vermilion, they form extensive bluffs, in some cases one hundred feet high. Two members are here represented; the upper consisting principally of heavy beds of sand and coarse gravel, with occasional thin layers of clay, which, where near the surface, have been discolored by the oxydation of the small portion of iron which they contain, and appear as yellowish and reddish-brown beds, but, at greater depths, still retain the original blue tint which is the prevailing color of the lower members.

In connection with these upper beds of the Drift, and also with the Loess, we find, scattered over the surface of the county, many large masses of limestone and occasionally sandstone. In several cases, these are so large and so deeply imbedded as to have induced the belief that they were the outcropping edges of solid beds of rock. Some of these masses are composed of a beautiful, light, fawn colored limestone, of a homogenous, fine grained texture, and destitute of fossils, so far as noticed. Kilns of lime have been burned, from rock of this character, one or two miles north of Rossville, and also about one mile south of Mann's chapel, in section 36, town 22 north, range 12 west. One mile south of this latter locality, and also at about the same distance to the northwest, there were observed several large masses of a dark, semi-crystalline, bituminous limestone, with a few fossils. The rock is supposed to be Silurian. Smaller fragments of the light colored rock are not unfrequent to the southward, even as far as Terre Haute. The general appearance of the stone would indicate that it belongs to the Coal Measures, but no outcrop of an exactly similar rock is known, so that its origin is uncertain. In the western part of this county, and in the adjoining part of Champaign, there are numerous scattered masses of a light drab, semi-crystalline or fragmentary to massive, sometimes shaly, limestone, highly fossiliferous, which belong to the bed marked No. 1, in the general section of the rocks of the county, and indicate its former extension toward the north and west. Many of the other rocks of the county are also locally distributed in connection with these upper beds of the Drift, as at Danville, where, in the banks of gravel stripped from over the coal, we find very numerous thin slabs of a compact, fragmentary to semi-crystalline limestone, containing numerous fragments of fish teeth—No. 21 of the general section—which, at Rock ford of Salt fork, lies ninety-five feet above the Danville coal. These beds, also, not unfrequently contain fragments of coal and shale, which have led many persons to suppose that coal was necessarily close at hand. But they also contain lumps of native copper transported from Lake Superior, and bits of lead ore from the Galena region; and it is by no means certain that the coal of the same beds has all been taken up from the immediate neighborhood where it is found. These masses of coal and shale are abundant in these beds, as far as Lake Michigan at least, and it is still an open question whether they have been swept down from the Michigan coal fields, or are the remnants of some broken up beds which may formerly have connected that with the Illinois field.

Both these beds and the lower member of the Drift formation give rise to numerous springs, some of which have taken up so much lime from the limestone pebbles which fill the gravel, that, upon coming to the surface, they make abundant deposits of tufa, as along the bank of the Big Vermilion, at Danville, and especially at the "Moss Bank" on North Fork, about one mile northwest of that city. Some of the deposits are light and porous, and take beautiful impressions of the mosses, twigs, and leaves which become imbedded in them. Recent snail-shells, thus fossilized, are not rare. In other cases, the deposition has gone on more slowly, and without the introduction of extraneous matter, and we find as the result some very solid masses with a radiating semi-crystalline structure, which approximates more nearly the ordinary stalagmitic formations.

The lower member of the Drift—the "boulder-clay"—is a tough, light-blue clay, filled with gravel of various degrees of fineness, with some larger boulders. In this county, it is from fifty to eighty feet in thickness, and forms some considerable bluffs, as at Mills's mill, on Middle Fork, where it is capped with the gravel and sand of the upper member. It also forms the mound at Kyger's mill, near the mouth of Grape creek. Here, the river ran for centuries to the west of the mound, and excavated a broad valley, which is now deserted and partially filled up, and the stream passes to the eastward, leaving a small island of the boulder-clay, which presents an almost perpendicular face on the east side, where it is now undermined by the current. Curiously enough, a spring of cold water flows out at the top of this mound.

Coal Measures.—The rock formations of this county all belong to the Coal Measures. The following is a general statement of the section, from the highest beds seen in the county to the junction of the Big Vermilion, with the Wabash river below Eugene, with the addition of the section from the lowest beds there seen to the bottom of the Lodi salt well, as carefully determined and reported by John Collett, Esq., of Eugene. It was found necessary to make these connections with the Indiana field, both in order to judge of the beds underlying Vermilion county, and also to connect the section in Vermilion with that in Edgar county:

		FEET.
1.	Light drab limestone	12 to 18
	Level of coal No. 12	?
	Covered	?
2.	Shaly sandstone, with some solid beds	25 to 50
3.	Olive, dark red and light blue clay shales, lower part sandy and micaceous, with bands of argillaceous limestone	5 " 20
4.	Black shale	0 " 3
5.	Coal, No. 11?	0 " 1½

		FEET.		
6.	Fire clay	0	to	2½
7.	Sandy shales	0	"	10
8.	Light drab clay shales, with ironstone nodules	0	"	15
9.	Argillaceous limestone, with shaly partings	½	"	4
10.	Black shale, some slaty	½	"	3
11.	Coal, No. 10?	0	"	2
12.	Drab fire-clay	3	"	6
13.	Light drab sandy shale, with iron veins	6	"	8
14.	Black shale, with ironstones—*Cardiomorpha*, etc	½	"	2
	Level of coal No. 9		?	
15.	Variously colored shales and clays, with bands of concretionary argillaceous limestone	8	"	40
16.	Sandy shales and shaly sandstones	15	"	20
17.	Soft drab clay shale	0	"	1
18.	Shaly sandstone, with *Caulerpites*			10
19.	Argillaceous and ferruginous limestone—few fossils	½	"	2
20.	Dark drab shales, with ironstones	20	"	25
21.	Limestone, semi-crystalline to concretionary	4	"	8
	Level of coal No. 8			
22.	Coarsely concretionary clay shale	8	"	10
23.	Carbonaceous sandy shale and shaly sandstone	15	"	40
24.	Fine-grained sandy shale, with ironstones	30	"	40
25.	Dark and light drab clay shale—bottom fossiliferous	10	"	30
26.	Soft black shale, with pyritous fossils and nodules	0	"	5
27.	Coal, No. 7	3½	"	7½
28.	Fire-clay	0	"	3½
29.	Coal, (parting of No. 7,)	0	"	2
30.	Fire-clay	6	"	15
31.	Sandy shales and shaly clay	9	"	12
32.	Compact silicious limestone	1	"	1½
33.	Dark shaly clay	5	"	10
34.	Coal, No. 6	3½	"	7
35.	Fire-clay, with concretionary limestone	5	"	20
36.	Sandy shales with ironstones—some quarry-stone near top	50	"	80
37.	Clay shales, with few ironstones	20	"	40
38.	Black concretionary ferruginous limestone	½	"	3
39.	Black clay shale, some slaty	3	"	6
	Level of coal No. 5			
40.	Soft, light drab shale	½	"	1
41.	Shales and sandstones	15	"	30
42.	Dark drab clay shales	5	"	20
43.	Argillaceous limestones, changing to calcareous ironstone	1	"	3
44.	Sandy shales, with some heavy beds of sandstone, with some ironstones and "cone-in-cone"	35	"	40
45.	Black slaty shale, with ironstones	2	"	3
46.	Coal, with bands of shale, No. 4	4	"	14
47.	Shales, with limestone bands	10	"	20
48.	Black slaty shale, with some cannel	2	"	3
49.	Coal No. 3	1	"	1½

		FEET.
50.	Fire clay and Stigmarial sandstone	4 to 6
51.	Shales, with limestone band	10 " 15
	Top of Lodi Salt well	
52.	Argillaceous limestone and calcareous shale	4 " 8
53.	Coal No. 2	1 " 5
54.	Fire clay, and shale with iron nodules	1 6 in.
55.	Hard white sandstone	20
56.	Argillaceous sandstone, with thin streaks of coal	10
57.	" " white	8
58.	Laminated sandstone, with ironstones at bottom	16 9 in.
59.	Sandstone and shale	12 7 "
60.	Sandy shale, with streaks of coal and slate	17 1 "
61.	Buff and white, fine grained, micaceous sandstone, bottom coarser	20
62.	Black and drab clay shale, some sandy layers at bottom	8 11 "
63.	Coal, "Conglomerate seam"	1 6 "
64.	Black shale	12
65.	Soft clay shale, or fire clay	19
66.	Hard sandstone	32
67.	Clay shale, few bands of sandstone	24 1 "
68.	" frequent bands of sandstone	30 7 "
69.	Very hard sandstone	2 3 "
70.	Sandy shale	60 7 "
71.	Fine sandstone	46 5 "
72.	Shale, some portions sandy	92 11 "
73.	Hard fine sandstone	2 9 "
74.	Shale, with bands of coarse sandstone	95 1 "
75.	Hard sandstone	6 10 "
76.	"Flint," (probably compact limestone bands, possibly a geode bed)	8 2 "
77.	Shale, some sandy	44 11 "
78.	Compact, coarse, sharp sandstone, with pyrite	10 3 "
79.	Fine sandstone, some shaly layers	54 7 "
80.	Soft clay shale	8 8 "
81.	Shale, with some fine grit	65 5 "
82.	"Flint"	1
83.	Porous sandstone	7 8 "
84.	Clay shale	5 3 "
85.	Compact white sandstone	40 5 "
86.	Sandstone, with flinty layers	34 1 "
87.	Flint	1 6 "
88.	Soft sandstone, top ochreous	9 4 "
89.	Soft clay shale	39 5 "
90.	Shale, with compact sandstone at bottom	26 2 "
91.	Bituminous shale	102 1 "
92.	Hard, coarse, calcareous sandstone, fossiliferous	23 1 "
93.	White fossiliferous limestone	9 10 "
94.	Flint	2 2 "
95.	Magnesian limestone	7 10 "

		FEET.	
96.	Flint	10	10 in.
97.	Compact limestone, with flint	22	
98.	Magnesian " "	23	10 "
99.	Soft, fine sandstone	5	
100.	Compact, fine sandstone	10	
101.	Gray limestone	6	
102.	Hard drab to the semi-crystalline limestone, with drusy cavities	28	10 "

No. 1, of the foregoing section, as already stated, is a light drab or fawn colored, fine grained, sub-crystalline to massive limestone, in some parts quite pure, in others somewhat shaly and slightly ferruginous. It is generally quite fossiliferous, containing *Productus*, 2 or 3 sp., *Spirifer lineatus*, *S. cameratus*, *Athyris subtilita*, *Terebratula bovidens*, etc. The only known outcrops in this county, are near Big Spring, south of Fairmount, on section 16, township 18 north, range 13 west, and for two or three miles south and west of this point. The bed is here said to be from fifteen to eighteen feet thick, though the bottom has never been certainly reached, and only from five to ten feet are now exposed. Some lime has been burned here, and considerable portions of the bed seem well fitted for that use. It is too irregular, and breaks up too readily with the frost to be of any value as a building stone. The same bed occurs at several points in Edgar county, where portions of it afford very solid stone, fitted for any rough work, such as foundations and culverts. The supposed outcrop of this rock at Osborn's mill, on Salt Fork, a half mile east of the county line, is only one of the large drifted masses before mentioned. From below this limestone, flow very strong springs; therefore, although there is no outcrop of rock on the south side of the water-shed toward the Little Vermilion, where we should naturally expect to find it, I am inclined to consider the strong springs on the land of John M. Sidell, near the west line of township 17 north, range 13 west, on the north side of the Little Vermilion, as pretty good signs of its presence at that point. Still, some other circumstances may have given exit at that point to the water, which, in both cases, doubtless comes from the great water-bearing quicksand of Champaign county.

Below this limestone, there is in the section a space of undetermined thickness and character, since no outcrop has been found which will give a connected view of this and the sandstone beds numbered "2," and no borings have been made in this neighborhood to decide the matter. It is entirely possible that the limestone belongs below this sandstone, and is simply missing from its place in the section along Salt Fork, in consequence of having been removed by the heavy erosion which the beds in that region evidently suffered before the deposition of the sandstone No. 2. There is, however, at present, no sufficient reason for believing this.

No. 2 of the section is first met with in following down Jordan creek, about two miles north of Fairmount, in the south half of section 27, town 19 north, range 13 west. It is here a very shaly rock, and of no practical value; but in sections 20 and 21 of the same township, above and below the Conkeytown bridge over Salt Fork, it furnishes some more compact beds, which have been quarried for foundations and bridge abutments. One of these layers, near the bottom of this bed, from one to two feet thick, is a very solid stone, and would pay for quarrying if the quantity were greater. From its outcrop along the base of the river bluffs, considerable quantities have been gathered for use at Fairmount. Less compact layers, from the upper part of this bed, are quarried, to some extent, at Davis's quarry, in the south part of section 31, of this township, and are said to become hard and durable under the action of the weather, on account of the contained oxyd of iron. Other openings in this neighborhood are now abandoned.

These are the highest beds exposed upon Salt Fork. In going but short distances up and down the stream, we come upon the underlying thin coal seam, with its accompanying black shales and argillaceous limestones, so that this is evidently a point of the north and south axis of the synclinal between the eastern border of the coal field and the axis of elevation which has been noted as running about south 33° east from the neighborhood of LaSalle. This latter axis must evidently pass through the adjoining county of Champaign, though the upper strata were there so extensively removed before the Drift period, that no outcrops now exist to show what the actual dip is.

Through the eastern part of Vermilion county, the dip is mainly to the southwest, at a small angle, though local dips are very various. In ascending Salt Fork, these characters are constant until we pass the west line of township 19 north, range 12 west, where the dip becomes much more rapid for a few miles, and until it is reversed at the synclinal, above which the eastward dip is very gentle.

Nos. 4 to 12 of the section are exceedingly variable in their characters and succession, so that it is very difficult to give a general section which shall fairly represent their different aspects. Their most noticeable components are the bands of argillaceous limestone near the top of the series, which are sometimes compact and sometimes marly, but always contain great numbers of fossils, especially *Hemipronites crassa* and *Productus longispinus*, together with *P. costatus*, *P. Rogersii*, *P. scabriculus*, *Athyris subtilita*, *Spirifer cameratus*, *S. plano-convexa*, *Spiriferina Kentuckensis*, *Retzia punctilifera*, *Cyathoxonia prolifera*, plates of *Zeacrinus*, and various Bryozoa. The black shales which appear, sometimes above, sometimes below, and sometimes between these limestone bands, are sometimes soft and sometimes slaty; under all which variations, we find them containing a few specimens of *Discina nitida*, *Lingula*, and rhombic fish-scales.

Above the synclinal axis, the coal accompanying these beds is pretty constant, with a thickness of six to twenty inches; further east, it is very thin, and in some cases disappears. Near the west line of section 35, town 19 north, range 14 west, I also found a point where the whole of these beds had been removed by erosion, and the shaly sandstone of No. 2 had been deposited directly upon No. 13. These beds also occur just above the mouth of Stony creek, with six inches of coal. In ascending this creek, no rock was found above No. 2, which forms the banks just above the crossing of the State road, in section 22.

In descending Salt Fork, the black, slaty shale of No. 14 is found in the tops of the hills below Major's mill, accompanied by large concretions of black, calcareous ironstone, containing *Cardiomorpha Missouriensis*, *Orthoceras*, *Nautilus*, and fish-scales.

The shales of No. 15 are generally green and red. The limestone bands accompanying them are in some places crowded with fossils, such as *Myalina*, *Nucula*, *Leda*, *Monopteria*, *Aviculopecten*, *Bellerophon*, *Macrocheilus*, *Hemipronites crassa*, *Athyris subtilita*, *Productus scabriculus*, etc. The best locality is about eighty rods below Major's mill, on the north bank of the Oxbow bend.

No. 18 is a shaly sandstone, which furnishes a good horizon for recognition, since it is characterized by a great abundance of more or less perfect fronds of the fucoid *Caulerpites marginatus*, Lesqx. This is found to occupy nearly the same position in the section in Edgar county.

No. 19 is analogous in character with Nos. 3 and 9, and contains the same fossils, with the addition of *Myalina*, *Orthis carbonaria*, and scales and teeth of fishes.

No. 21 is generally a very compact, fragmentary to semi-crystalline limestone, ringing under the hammer, and marked by the presence of numerous bony scales and teeth of fishes. At Rock Ford, below Major's mill, in the northwest quarter of section 25, township 19 north, range 13 west, this bed presents a very curious structure, having been apparently coarsely broken up by some violent action, and afterward reconsolidated by the deposition of a cement of a calcareo-ferruginous material, mingled with some sand. I have been unable to conceive of any circumstances which could have produced just such a bed of rock. It has been named to me as the result of volcanic action, but that is impossible.

Apparently belonging at the bottom of this bed, though the connection could not be clearly made out, is a bed of impure, concretionary limestone, which has occasionally been burned for lime in a ravine just east of Finley chapel, on the southwest quarter of section 18, town 19 north, range 12 west. Only a small outcrop is here exposed, and only a few fragmentary fossils were detected; but at Garrett's (formerly Swank's) old mill, on the Little Vermilion, in the northwest quarter of section 14, township 17 north, range 12 west, we find a considerable outcrop of the whole of this bed, except the peculiar conglomerate just mentioned, which is evidently local. In the outcrop of about two hundred yards, there are great variations, from the very compact clinking stone, with fish remains and large valves of *Productus costatus*, to an impure, concretionary, almost granular limestone, crowded with generally quite small fossils. Among these we find *Spirifer cameratus*, *S. lineatus*, *Spiriferina Kentuckensis*, *Athyris subtilita*, *Terebratula bovidens*, *Orthis carbonaria*, *Productus longispinus*, *Waldheimia* (*Cryptacanthia*) *compacta*, *Retzia punctilifera?* *Nucula*, *Bellerophon*, *Loxonema*, *Naticopsis*, *Fusulna cylindirica*, etc.

At Rock Ford, as previously stated, this bed was found to be about ninety-five feet above the Danville coal seam, No. 27 of the general section. But this distance is far from constant. My *estimate* of it on the Little Vermilion, where the broken condition of the section rendered connected measurements impossible, was not far from eighty feet; while, in the shaft at Catlin, as I am informed by Mr. John Faulds, of that place, one hundred and thirty feet of sandy and argillaceous shale were passed through above the coal, without any intercalated bed of limestone.

This coal-seam appears above the level of the river, near the east line of township 19 north, range 13 west; but owing to the local undulations before mentioned, it dips, rises and dips again, two or three times before making its final emergence a short distance below the mouth of Middle Fork. Up that stream, also, we find the coal in or not far below the bed for about two miles, to near the north line of section 8, township 19 north, range 12 west, where a sudden dip carries it below the level, and brings in the upper beds to the top of No. 16, which, on Makemson's branch, in the west half of section 5, contains a heavy bed of very solid ferruginous sandstone, which appears well fitted for building purposes, though no quarry has been opened. Still ascending the stream, we find the rocks rising, somewhat; but, at the last rock exposure, on Mr. Cox's land, in section 32, township 20 north, range 12 west, the coal is probably still from forty to fifty feet below the water level. Above this point, we come upon the heavy beds of Drift clay and gravel which cover the north part of the county so deeply as to render the exact location of the underlying rocks impossible, except by boring.

The so-called "Danville" seam of coal, No. 27 of the section, is apparently equivalent to that which is numbered "6" in the general section of the coals of the Illinois valley (see Ill. Rep., iii., p. 6); but, as the numbering there adopted will not accommodate all of the seams which have a well-defined level in the field now under consideration, I am compelled to adopt, *provisionally*, another set of numbers for the coals of the Wabash valley. I regret that the impossibility of determining, at the present time, the number and constancy of the seams near the base of the series, east of the Wabash, has thus far prevented the adoption of a numbering which may be considered permanent. The numbers here used, however, correspond, at least so far as concerns the seams outcropping in Vermilion county, with those adopted by Professor Cox, in his reports upon the eastern counties of the southern part of the State.

In the neighborhood of Danville, coal "No. 7," or the "Danville" seam, outcrops for many miles. It is here generally covered by from two inches to five feet of a soft black clay shale, rarely a little slaty, which commonly contains large numbers of fossil shells replaced by pyrite. This mineral is also frequently present in the form of irregular crystals and nodules of various sizes. Small nodules, apparently composed of phosphate of lime, also occur, generally inclosing fragments of fish scales: one has yielded the three-pronged tail of a *Dithyrocaris*. Among the most characteristic of the species which crowd this bed, are *Aviculopecten rectalaterarea*, *Entolium aviculatum*, *Lima retifera*, *Solenomya radiata*, *Sanguinolites carbonarius*, *Macrodon tenuistriatum*, *Pernopecten*, *Myalina attenuata*, *Leda bellastriata*, *Gervillia longa*, *Nucula parva*, *Astartella*, *Chonetes mesoloba*, *Discina nitida*, *Lingula umbonata*, *Productus scabriculus*, *P. longispinus*, *Rhynchonella Osagensis*, *Dentalium Meekianum*, *Chiton*, *Euomphalus rugosus*, *Bellerophon carbonarius*, *B. Montfortianus*, *Pleurotomaria Grayvillensis*, *P. carbonaria*, *P. Beckwithana*, *Macrocheilus ventricosus*, *M. Newberryi*, *Orthoceras Rushensis*, *Nautilus* 4 sp., several minute species of *Actæonina*, *Polyphemopsis*, etc. Where the bed is at its greatest thickness, is quite it solid, and the fossils are generally readily preserved: but, in the thinner portions, it is very fragile, and the superabundance of pyrite, in such condition as to be readily decomposed, renders their preservation very difficult. Where the black shale is thin, or entirely wanting, the overlying drab shale, which replaces it, becomes fossiliferous in turn, though elsewhere generally barren, and yields many of the same fossils, though rarely in good condition. This bed can be seen at the upper end of Donlon & Chandler's "strippings," opposite Danville, below the railroad bridge, and also along Ellis's branch, near Georgetown. The black shale is at present most accessible, in its fragile pyritous presentation, at Kelly's strippings, about one mile northwest of the court house, and at Short's strippings, across North Fork, opposite Danville, and in its more solid condition, along the inclined plane at the old Carbon company's mines, near Tilton.

The coal is very variable, both in character and thickness. Near Danville, along Salt Fork above that place, and at Lafferty's bank, on Grape creek, it varies from five feet six inches to seven feet three inches in thickness. About Georgetown, the only place in the county where it has been opened, south of Lafferty's, it is said to vary from three to four feet; at the few points where it was accessible, I could find no thickness over three and a half feet. It is said to be here of very poor quality, and the mines are abandoned.

This seam is mined at the Horse Shoe bend of the Little Vermilion, five miles above Newport, Indiana, with a thickness of from four and a half to five feet, and a heavy limestone roof. Further south, we find its equivalent in the seam worked near the Indiana Furnace, on Brouillet's creek and its branches, west of Clinton, Indiana, and also at the base of the hills north of the national road opposite Terre Haute.

Immediately below this seam, and properly forming a constituent part of it, though separated, near Danville, by a variable thickness of fire-clay, is the so-called "Blacksmith's seam," of from ten inches to two feet of good coal. Though the separation increases rapidly as we ascend Salt Fork, it is probably only local, and the partings are not likely to attain anywhere the dignity of distinct seams. In the Catlin shaft, the division is not noticeable, except by the more ready separation of a few inches from the bottom of the main seam in mining. At Georgetown, and southward, no such division is noticed.

Both the thickness and the character of the strata between this and the "Grape Creek" seam, No. 34, vary considerably. Along the Big Vermilion, especially in the nighborhood of Danville, we have generally from twelve to fifteen feet of fire clay, rarely with nodular limestone and soft shale, the latter partly sandy, underlaid by a very compact layer of limestone, partly silicious, partly nearly pure, which contains some fragmentary fossils, but nothing characteristic. Below this, and forming the roof of the lower coal, No. 34, we have a few feet of a dark drab, sometimes black shaly clay, in which no fossils were noticed. Though the different beds vary as indicated in the section, the whole thickness, in this part of the county, rarely exceeds twenty feet, and is often not more than sixteen feet. Along Grape creek, just below the distillery on the northwest corner of section 33, township 19 north, range 11 west, the lower seam is covered by three or four inches of soft black shale, followed by from twenty to thirty feet of drab clay shale, becoming sandy above, which, two hundred yards below, are replaced by a heavy bank of sandy shales and shaly sandstone, with some solid bands of quarry rock. I was unable to decide from the partially covered outcrop, whether this was simply a change in the character of the layers, or whether the shale had been removed, and the sandstone deposited in the eroded basin. At least forty or fifty feet of strata are here exposed above No. 34, without bringing in any representative of No. 27. Along the creek, above the distillery, there are indications of a low anticlinal, with confused dips; and I was at one time inclined to refer to the "Grape Creek" seam proper, the coal mined at and near Lafferty's, which here shows characters and accompaniments intermediate between those of coals Nos. 6 and 7; but the weight of evidence finally turned in favor of No. 7.

Along the Little Vermilion, below Georgetown, the intervening strata have thickened up still further. It would be difficult to measure an exact section; but the following is approximately correct:

	FEET.
Coal, No. 7	2 to 3½
Fire clay	6
Micaceous shale, some fine sandy, with few nodules of argillaceous limestone	10 " 15
Sandy shales and shaly sandstones, some quarried	30 " 40
Drab clay shales, with large ironstones	15 " 20
" " " small ironstone nodules and bands	30 " 40
Fine grained, micaceous, carbonaceous clay shales	10 " 15
Fine grained, micaceous, carbonaceous clay shales, with flat nodules and thin bands of ironstone; bottom darker, with *Leaia* and fern leaflets	12 " 15
Coal, No. 6	4

This outcrop of the lower seam of coal is reached about three miles below Georgetown, near the northeast corner of section 3, township 17 north, range 11 west. The roof shales are in places crowded with the separated compressed valves of *Leaia tricarinata*, accompanied by a few scattered fragmentary fronds of ferns. The *Leaia* was found abundant, in the same position, upon Yankee branch, in section 14, of the same township. It is also found uncompressed, but in less abundance, in some of the small ironstone nodules of the overlying beds, where it accompanies considerable numbers of ferns, among which are found *Neuropteris hirsuta*, *N. rarinervis*, *N. vermicularis*, *Pecopteris Bucklandi!*, *P. oreopteridius*, *P. villosa*, *P. Miltoni?*, *Odontopteris Schlotheimi*, together with *Stigmaria ficoides*, *Sigillaria Brardii*, *S. monostigma*, *Lepidophyllum majus*, *Lepidodendron rugosum*, *Lepidostrobus variabilis*, *Calamites approximatus*, *Asterophyllites* and *Equisetites?* One nearly perfect insect found here, probably belonging to the genus *Miamia*, is in the collection of Dr. J. C. Winslow, of Danville. This same bed of nodules, containing the same set of fossils, excepting that the *Leaia* has not been noticed; outcrops on the bank of the Wabash at Durkee's ferry, about six miles above Terre Haute. In the southern part of this range, the roof of the coal is a black, bituminous shale, often slaty, three or four feet thick, accompanied by huge concretions of pyritous ironstone.

No. 34 is apparently the equivalent of coal No. 5, of the Illinois Valley section. Along the Wabash valley, its outcrop is nearly continuous from above Danville to where it dips under the river between Clinton and Durkee's Ferry. Its thickness is variable: about Danville, sometimes less than four feet; two or three miles farther south, five to six feet; on Grape creek and its branches, five to seven feet; on the Little Vermilion, near Georgetown, four feet; at the Horse Shoe, above Newport, five to seven feet; near Clinton, five to six feet. It is generally a free burning coal, much freer from sulphur than the upper seam, and better liked for domestic use. Along Grape creek, there is a thin clay parting about four feet from the top of the seam, analagous to that in the upper seam. I cannot say whether this is constant further north; further south, it is generally present throughout the outcrop. In the northern part of its outcrop, this seam is capped by from six to ten inches of cannel; but this character is not common.

The fire clay, No. 35, is, in some places, very largely developed, as on Trosper branch, about four miles northeast of Georgetown, where, below the opening of the coal seam, on the northeast quarter of section 22, township 18 north, range 11 west, I measured fifteen feet of clay in several alternating bands, with from three to four feet of nodular, argillaceous limestone, and was not certain that I had then reached the bottom of the bed, since the outcrop below was not exposed. The clay is here much variegated with streaks, blotches and beds of light blue, dark drab, dark brick-red, crimson and purplish tints, the red portions furnishing the boys with an unlimited supply of "keel." The accompanying nodular bands of limestone occasionally contain fragments of fossils, but nothing characteristic. Possibly, some of the lower of these bands may be the practical equivalent of the fossiliferous limestones at the Slip-bank, below the Horse Shoe of the Little Vermilion, which, however, lie some thirty feet below the coal seam, the intervening beds being mainly fire clay and shales, with some sand, and a few ironstones. The nodular limestones accompanying the fire clay of this seam, at Pettys's ford of the Little Vermilion, about four miles below Georgetown, have recently been found to contain considerable numbers of small land snails of two species, one apparently identical with the *Pupa vetusta* of the Nova Scotia Coal Measures, and the other, possibly a *Zonites*, but smooth.

The beds numbered 33 in the section, are exceedingly variable. The upper layers, which are generally rather soft, contain, near and opposite Danville, from one to five bands of a very hard, calcareous sandstone or silicious limestone, varying from six to eighteen inches in thickness. Where exposed to the weather, these are very hard and tough, but are softer below the surface. Perhaps fifteen feet below the level of the floor of the coal, we find, at Leonard's quarry, a mile or so below Danville, a thick bed of gray, highly ferruginous sandstone, which is in much favor as a building stone. The bed is not constant, running into sandy shale within a short distance. The lower beds of this member of the series are all soft shales, of no practical value, and are entirely destitute of fossils. For some distance below Danville, they form a set of high bluffs, reaching seventy or eighty feet at least.

After passing below Kyger's mill, near the mouth of Grape creek, the black limestone and shales of Nos. 35 and 36, come above the water, and continue to form the prominent feature of the river banks to below the State line. They deserve notice only as indicating the level of coal No. 5, which is here wanting, though it begins to make its appearance at White's mill, on the Little Vermilion, four miles above Newport, with a thickness of four inches, and continues along the outcrop southward, with a general thickness of ten or eleven inches, nearly to Clinton, where it dips below the river level. At Hawley and Hett's bank, on Norton's creek, about four miles above Clinton, it is locally thickened up to from twenty inches to two feet. The overlying shales, through all the outcrop, are generally quite full of the conical, bony teeth, or dermal scales of *Petrodus occidentalis*, constantly accompanied by the long, slightly curved, and fringed fin-spine, and the small rhomboidal scales which there is every reason for referring to the same species. The accompanying black ferruginous limestone commonly contains more or less of the same fish remains, accompanied by *Cardiomorpha Missouriensis.*

The beds of the lower part of the section show no outcrop within this county, but as they will very probably be met with in any moderately deep borings which may be made near the State line, east and northeast of Danville, it was thought best to complete the section as far as possible; and some general statements regarding these lower beds may not be out of place here.

No. 43 is a valuable bed of low grade ironstone. No. 44 generally contains a heavy band of tolerably compact sandstone, such as forms the Hanging Rock on the Big Vermilion, a few miles below the State line. No. 46 commonly presents two or three, and sometimes four or five partings of coal, separated by shale and fire clay, some of which are occasionally thick enough to work profitably. No. 49 is too thin a seam to command attention, until nearly the entire supply of the tolerably thick seam in the neighborhood has been used up. It outcrops along the Big Vermilion below Eugene. No. 53 is a thick seam of semi-block coal, tolerably well fitted for smelting iron in the raw state. Two or three seams of coal occur below this, at Thorne's ferry, just below the mouth of the Big Vermilion; but, as their extent and regularity are unknown, and they are not represented at the point where the bore of the salt well was put down, it was thought best to omit them from the general section. They probably represent partings of coal No. 1. Below all these coals, but not represented in the section, from lack of certain connections, is the heavy bed of limestone, with underlying shales, at Perrysville, Ind. These beds are full of fossils, and it is interesting to note that among them are some of very wide distribution, such as *Athyris subtilita*, *Petrodus occidentalis*, and *Aviculopecten rectalaterarea*, the latter of which was formerly considered especially characteristic of one seam, but which presents itself to the explorer in every one of the black shales of the general section, from this basal bed to No. 4 of the section.

Economical Geology.

Coal.—After the fertile prairie soil, which has been already spoken of, this mineral naturally occupies the first place in an enumeration of the natural resources of Vermilion county. Two heavy seams underlie the larger part of the southern half of the county, both of which could be worked, at depths varying from nothing up to probably nowhere more than three hundred and fifty feet, in all that portion of the county west of a line passing north and south through Danville, and south of the north line of township 19 north, with the exception of about one section in the northwest corner of township 19 north, range 11 west. Both seams are constantly present along the entire outcrop, and there is reason to believe that both will be found of workable thickness at all points where their level shall be reached in the county.

The upper seam is largely worked at and near Danville, both in shafts and strippings. At this point it has more than twice the thickness of the lower seam, and is accordingly made a source of supply, although of inferior quality. This fact, together with the carelessness of the miners, in not duly separating the slaty and pyritous portions of the seam from the good coal, has tended to impair the reputation of the coal of this county. As a fair estimate of the character and value of the coal, I append the following letter from Maj. Joseph Kirkland, now of Chicago, who has owned and worked coal mines in this region for many years:

307 Huron Street, Chicago, *Dec. 25th*, 1858.

Prof. Frank H. Bradley, *Assistant Geologist of Illinois:*

My Dear Sir: The coal of the main Danville seam is a strong, fat, soft, caking coal; averages six feet thick, lies nearly level, dipping say ten feet per mile toward the southwest; is hardest and most impure in its lowest stratum of eight inches or so; purest and best in the "blacksmith coal" stratum, one and a half to two feet next above, and more and more friable as you near the roof. The seam contains probably quite as much sulphur as other Illinois coals, but it is in masses, thick layers or nodules, easily separated and thrown out, and therefore less of a detriment in use than would be a smaller proportion more intimately associated with the body of the coal. The roof is generally not good in the workings so far explored. The coal at all the mines (say six miles apart at farthest) is nearly equal in quality, though harder and therefore better in proportion to its distance from surface and outcrop. Its money value in general markets is about ten per cent. less than the best Illinois coal, and say fifty per cent. less than the best bituminous coal mined in the country.

There is no doubt as to the existence of two seams of coal at and near our workings. The main one is that we are working, and is that I have described. The second is from one foot to two or more in thickness, and is about sixteen feet below the upper, at our mine. You can see it at many bluff exposures on the Vermilion; also, in the well which supplies our mine engine with water. The mooted point is the existence of a third seam reported, at say eighty feet below the upper seam, by the traditions of the old salt works borings; which legends also report it to be sixteen feet in thickness.

Some Geologists (Col. J. W. Foster, of Chicago, for example,) have concluded that there is such a seam, and that it is identical with the "Grape Creek" coal, a development six miles or so south of Danville, of a superior quality of coal. The Chicago and Carbon Coal compony sunk an experimental well (under my superintendence), starting in the ravine at a point about twenty feet below the working seam of coal (below the second seam) and prosecuted down some eighty feet, finding no coal; nothing but a continuation of the pale, sandy shale, hard while *in loco*, but disintegrating on exposure.

From the result of my observations and experience, and the absence of any known outcrop, northeast of the outcrop of the main seam of Danville coal, I am disposed to conclude that there is no such seam as the "third seam," reported from the "salt works" borings; or, if any seam exists at or near the locality and depth described, it is the thin "second seam" (2) I have spoken of, thickened up and become more distant from the main seam in the six miles intervening distance. At one place (just at the low water level of the Vermilion) on the north (left) bank of the "Salt Fork" of the Vermilion, about two miles above Danville, that "second seam" shows a well defined stratum of "block" or "cannel" coal. I think I called your attention to this part of this seam.

The main defect of the Danville coal is its friability and tendency to disintegrate or "slack" on exposure. It is a strong steam coal, and answers a very good purpose for all domestic uses.

Yours truly,

Joseph Kirkland.

Of analyses of coal from different openings in this seam, made some years ago, and published in 1858 by Dr. Norwood, in his Report on Illinois Coals, I give the following summary:

Specific gravity	1.213 to 1.2833
Average	1.2563
Moisture	3.4 to 8.6
Average	7.13
Volatile gases	40.1 to 42.3
Average	41.85
Carbon in coke	40.5 to 48.96
Average	45.96
Carbon in coal	49.8 to 55.5
Average	51.576
Ash	2 to 16
Average	7.25
Gray, bluish gray, and grayish white	

The principal openings from which the coal of this seam is now shipped, are the drifts of Messrs. Chandler & Donlon, and Kirkland Bros., on the bank of the Big Vermilion, opposite Danville, and the several shafts along the T. W. & W. R. R., as far west as Catlin. The mines of the Carbon Coal company, about two miles above Danville, along the river, were formerly extensively worked, and shipped their coal by a long branch track; but they are now deserted.

All the openings along the North Fork and its branches are on this seam, the lower seam being in all cases, apparently, thin and unprofitable. The last outcrop seen in ascending this fork is in the banks above Baldwin's old mill, in section 31, township 20 north, range 11 west, where the lower seam shows at the top of the bluff, but is apparently not worth working. It is worked, however, with a thickness of about four feet, at Leonard's mine, below the city, the last show of either seam in going eastward.

---

(2) The solution of this problem is found in my remarks upon the two seams on the previous pages. F. H. B.

The openings along Salt Fork, as far as the west line of township 19 north, range 12 west, are all in the upper seam, though, for two or three miles above Danville, the lower seam is exposed in every bluff, and in some cases with a thickness of four feet or more. Up Middle Fork, the upper seam has never been fairly opened, though small quantities of coal have at times been taken from the bed of the stream for local use, and it could be mined at about that level as far north as the north line of section 8, township 19 north, range 12 west; but the sudden dip previously mentioned here, carries it downward to probably one hundred feet below the level of the stream, and it does not again appear in going northward.

The lower or "Grape creek" seam is comparatively thin at Danville, in some cases not exceeding three feet*, and accordingly has not been worked sufficiently to ascertain its quality with certainty; but, on Grape creek, it has been worked by several drifts and strippings, with a thickness of from five to seven feet, and furnishes a superior coal. The portion below the clay parting would in most cases probably prove satisfactory, if used in the raw state for smelting iron. If nearer to railroad transportation, these mines might fairly compete with any in the State. The coal still contains small portions of pyrite, and here, as elsewhere, it appeared to me that this mineral became more abundant as the seam became thicker. At Blakeney's mine, on Possum Hollow, a branch of the Grape creek valley—the only mine in all this region where it is done—I found that care was taken to separate the pure from the impure benches of the seam, a difference of two cents per bushel being made in the price. As a consequence, much local trade was centering here, and I heard it spoken of in distant parts of the county. The following is a detailed section of the seam at this point:

	FEET.	IN.
Micaceous clay shale	8 to 10	
Pyritous coal	2	1
Pure coal		8
Pyritous coal	1	6
Soft drab shaly clay		½
Pure coal	1	
Pyritous coal	1	9
Fire-clay, with thin bands of nodular limestone	8	

Along the Little Vermilion and its branches, from about four miles below Georgetown to below the State line, there are frequent openings of this seam for local supply, but no extensive workings. The coal appeared good. If railroad facilities could be supplied to this part of the county, these mines would at once become of great value.

---

*I have not seen it where so thin as stated by Major Kirkland.

Two analyses of coals from this seam, given in the aforesaid report, are as follows:

Specific gravity	1.311	and	1.3127
Moisture	9.	"	6.4
Volatile gases	34.5	"	39.17
Carbon in coke	50.	"	48.93
Carbon in coal	58.8	"	53.
Ash, (white)	6.5	"	5.5

This seam has also been opened along Trosper branch, on J. Ogden's land, in the northeast quarter of section 22, township 18 north, range 11 west, about three miles northeast of Georgetown. At the time of my visit, the openings had caved in, so as to prevent examination; and I was informed that the coal here contained too much pyrite to be valuable.

The only other coal openings in the county are the small strippings of the thin seams Nos. 5 and 11 of the county section, which I have numbered provisionally as coals No. 10? and No. 11?, and whose character and distribution have been sufficiently described in the general description of the section. Small quantities of coal of very fair quality can be obtained here for local use; but the seams are not thick enough to make them of any economical importance.

Coal No. 8 (probably corresponding to No. 7 of the Illinois valley section—see Ill. Rep., Vol. iii., p. 5,) does not appear at its proper level, in the section of the rocks of this county, viz: under the limestone, No. 21 of the section. Its only appearance in all this region is at the Horse Shoe bend of the Little Vermilion, in the west half of section 20, township 17 north, range 10 west, about a mile east of the State line, where it comes in suddenly, with a thickness of from three to four feet, and a reported roof of black slaty shale. It does not continue to the southward, and there is no reason to expect that it will be found sufficiently developed to furnish any considerable amount of coal within the limits of Vermilion county, though small patches may be found in the region just west of the Horse Shoe.

Through the region between the Big and Little Vermilions, no coal seams have been developed; but there is every reason for believing that both "No. 7" and "No. 6" are in place under all the western portion of this area, except on the slopes toward and near the Little Vermilion, where "No. 7" can only be looked for high in the bluffs.

Where the State line crosses the Big Vermilion, the "Eugene" or "Hanging Rock" seam, No. 46 of the county section, is probably about fifty feet below the water-level, and, judging from the general dip of the rocks, should come to the surface, in going north, before we reach the railroad at "Illiana," or State Line station. In this region, however, the surface is unbroken, and no wells or borings have exposed the rock, the Alluvium and Drift being apparently rather deep. The "Hanging Rock" seam, however, even if found here, would not probably be thick enough to be worked with profit, in competition with the Danville mines. There is reason, however, for supposing that No. 53 of the section may be found in this neighborhood, at no very great depth, and this, if found, would be likely to yield considerable supplies of superior coal. No outcrops were found which would give any certain data for locating it; but a boring of two hundred and fifty feet would fully test the matter.

From somewhere in this neighborhood, the outcrops of the various strata seem to turn more northwestward; but shortly after passing down the south line of township 20, on all the branches of the Big Vermilion, we find the Drift deposits beginning to thicken so rapidly as to conceal all outcrops farther north; so that we are left to conjecture for the possibilities of that part of the county. Furthermore, there are no outcrops in Iroquois county to give us any hints; and the knowledge of the beds to the westward is too limited to furnish any certain data. From what we know, however, I am inclined to think that the "Danville," or at least the "Grape creek," seam could be found as far north as Higginsville, at a depth of perhaps one hundred and fifty feet, while the lower seams might be found at Rossville, at not over two hundred and fifty feet. But, with the Chicago and Danville railroad bringing coal from the Danville mines at low rates, it would be long before mines could be profitably opened at that depth, if the presence of the coal were ascertained. In the northwest part of the county, near and beyond Marysville, it would probably pay some enterprising man to bore for coal, unless the heavy bed of quicksand under the boulder clay, which has caused trouble in Champaign county, should be met with. Its undoubted presence in the southwestern part of the county—a well at Dallas encountered it at eighty-nine feet—appears to be the only reason to hesitate about sinking shafts there for mining either "No. 7" or "No. 6," both of which seams probably underlie the whole of that part of the county.

An average thickness of eight feet of workable coal appears to be a sufficiently low estimate of the two principal seams, over their indicated area, which will include about three hundred square miles. At the usual estimate of one million tons per square mile for each foot of thickness, this would give 2,400,000,000 tons of avaliable coal supply. With the probabilities above stated, as to the existence of workable seams outside of the limits here calculated for, it would be a very moderate estimate to increase these figures to 3,000,000,000 tons, which, at the average price at the mine of $1.50 per ton, would yield to the county $4,500,000,000; and by rise in value, the actual receipts will probably much exceed this.

The present shipment and consumption of coal, from all the mines of the county, is estimated by Col. W. P. Chandler, of Danville, at about 75,000 tons per annum. At that rate, the supply will last only 4,000 years; and the consumption is increasing. Alas! for our descendants.

As already stated, the "Grape creek" seam, "No. 6," has, in some parts of the county, a cap of a few inches of cannel. Loose fragments of this have caused some profitless explorations for a seam of that material.

Lime.—All the lime now used in this county is brought from a distance, principally from Indiana. Along the railroads, there is no bed of limestone in the county; but at Big Spring, less than two miles from Fairmount station, there is an abundant supply of limestone, the larger part of which is suited for making lime. Small quantities have been burned here, in former years. At this point, it is true, there is no wood for fuel, but a shaft not over three hundred feet deep would furnish an abundant supply of coal for this purpose, while at the same time supplying a stretch of country which will soon furnish a large market for fuel. This is an especially favorable point for a shaft, having rock all the way from the surface, and thus avoiding the heavy bed of quicksand which would probably make trouble farther to the southward and westward. A little enterprise would make Fairmount the center of a large trade in both coal and lime. Several kilns have been burned along the upper course of the Salt Fork, from the drifted fragments of this bed.

The large drifted masses of Silurian (?) limestone which are quite numerous in the neighborhood of Mann's chapel and Rossville, have furnished, and will still furnish, small quantities of lime for local use. Small supplies could also be obtained from the outcrops of No. 21 of the county section, at and near Rock Ford on Salt Fork, and at Swank's mill on the Little Vermilion. The deposits of tufa from the springs near Danville, are not sufficient in quantity to be of any value.

Building Material.—Coal-measure sandstones are proverbially unreliable as building material; still, at three points in this county, considerable quantities of apparently solid sandstone can be obtained. Danville is at present supplied, for foundations and to a small extent for superstructures, from Leonard's quarry, about a mile below the city, on the river bank. The best stone is of a rather coarse grain, somewhat vesicular, and stained in spots with oxyd of iron. It appears to be a permanent stone. The beds do not continue solid through neighboring portions of the outcrop, and the supply of stone is therefore precarious. The following is a section of the quarry, as it appeared in May, 1868:

	FEET.	IN.
Olive shale, with purple streaks		8
Coal		1
Purplish shale	5	4
Gray, sandy shales	2	
Gray sandstone	16 to 18	
Gray and bluish shales	15	

On the opposite side of the river, not far from the same level, in the lower part of the ravine of the branch which flows through Donlon & Chandler's strippings, I observed four or five thin, irregular bands of a very compact, highly calcareous sandstone, of very irregular fracture, which are said to have furnished some stone for the piers of the T. W. & W. R. R. bridge. They appear solid in the outcrop, but the quantity is small, and the irregular fracture would interfere with ready working.

On Makemson's branch, as before mentioned, there are some heavy beds of ferruginous sandstone, which appear better fitted for resisting the action of the weather than any other stone in the county. They are underlaid by softer beds, which have been washed away by the stream, so as to leave the upper beds projecting many feet in some cases. They may be found somewhat soft in quarrying, but will harden upon exposure, and make a permanent stone, unless they are quarried so late in the season as to freeze before the quarry water is dried out of them.

Along Salt Fork, below Conkeytown, a layer near the bottom of No. 2 of the county section, has yielded small quantities of very solid, calcareous sandstone, apparently permanent. Above this point, stone has been quarried at several places. Davis's quarry, in section 31, township 19 north, range 13 west, is the only one now open. The stone is soft in the quarry, but is said to become very hard and durable upon exposure, in consequence of the cementing quality of a small quantity of oxyd of iron.

The limestone near Fairmount, so far as now exposed, is too shaky to be suitable for building. The upper layers of this bed, in Edgar county, have furnished some good stone for rough uses, and possibly corresponding beds may yet be developed here, especially at the southern extremity of the outcrop.

The drifted masses of Silurian limestone in the north part of the county, are still sufficiently numerous to be mentioned as a source of building stone for that region.

The clay subsoil throughout the timber, will furnish abundant material for brick making, and small quantities are manufactured at several points. The yard of Perry Fairchild, at Danville, is especially worthy of mention. It furnishes from three to four millions of brick per annum.

Fire Clay.—As already stated, this article exists in very large quantities below both of the principal coal beds, especially the lower one. The greatest development noticed is on J. Ogden's land, about three miles northeast of Georgetown. No use has been made of it, thus far; but it is well deserving of attention.

Iron Ore.—Along the banks of the Little Vermilion, for some miles below Georgetown, large quantities of nodular carbonate of iron are scattered and piled. The quality of the ore is not constant; but I judge that the larger part of it would yield from twenty-five to thirty-five per cent. of metal. The layers are so scattered in the shale, and so irregular in thickness, that no proper estimate of the quantity can be made; but, judging by the eye, there must be nearly or quite as much ore here as at the locality on Brouillet's creek, in Edgar county, which for years furnished an abundant supply of ore for the Indiana furnace, without any signs of giving out. On the Big Vermilion and its branches, just below the State line, I found a pretty constant band of a calcareous carbonate of iron, varying from one and a half to three feet in thickness, which may, at some points near Browntown, outcrop within the limits of the county. Upon the whole, there appears to be enough ore to warrant the erection of an iron furnace somewhere in this region, whenever a railroad shall furnish the requisite transportation.

Zinc blende has been found in small quantities in some of the ironstone nodules of the Little Vermilion, and small quantities of this mineral, disseminated in small grains through an ironstone just below coal No. 6, at the Horse Shoe of the Little Vermilion, has caused considerable excitement over the supposed discovery of "silver." The quantity is nowhere of any importance in this region.

Gold is met with in small quantities in certain thin gravel beds which accompany the boulder clay, but not in sufficient amount to be anything more than a periodical source of excitement to the ignorant.

Several large masses of *Native Copper* have been picked up in the Drift beds of this county. It is needless to say that they do not indicate any valuable deposit of this metal at any point nearer than the mines of Lake Superior, whence they have drifted. Here, as elsewhere, "the Indians" are credited with the knowledge of valuable lead mines in this region.

Salt.—Springs feebly impregnated with salt are known at several points in this region. The most notable is near the junction of Middle and Salt Forks, in section 16, township 19 north, range 12 west, where, during the early settlement of the country, a well was bored to a considerable depth, and salt made in large quantities. The following account of the work done here was taken from the lips of Harvey Luddington, Esq., of Danville, who was engaged in the work for some years:

The well was begun in 1819, by a small company, of which Messrs. Blackman, Treat and Beckwith, are remembered as the principal members, and deepened at intervals. The following is given as an approximate section of the materials passed through:

		FEET.
1.	Alluvium	19
2.	Coal No. 7	2 to 2½
3.	Blue fire clay	3 " 4
4.	Shale	90 " 100

		FEET.
5.	Coal* (and shale) No. 6?	16
6.	Fire clay	?
7.	Very hard gray rock	69
8.	Soft clay shale	175 " 200
9.	" " ?	75 " 100

The thinness of the upper coal is evidently due to a partial wearing away of the seam by the current of the river, before the deposition of the Alluvium.

The first digging only passed through the fire clay, and a brine yielding one bushel of salt to one hundred and seventy gallons of water was boiled at such a rate as to yield from forty to fifty bushels per week, with eighty kettles. Below the lower coal, a cavity of eighteen inches was found, from which flowed a much stronger brine, one hundred gallons of which gave a bushel of salt. The production was now about one hundred and twenty bushels per week, and the price, $1.50 per bushel. In 1825, Major Vance bought the works, and deepened the well, the boring being continued at intervals until 1827, but the strength of the brine did not notably increase. After the construction of canals and railroads, they were unable to compete with the Syracuse salt, and work was stopped and never resumed. The brine probably came from the sandstones at the base of the Coal Measures, and would have been found of greater strength if the well had been deepened considerably. From these lower beds, wells bored on the east side of the Wabash, have obtained brine of a strength of from 7° to 8½° Beaume. It would seem that, with the abundance of coal on the spot, the reduction of this ought to be made to pay.

This abundance of brine in the lower strata makes it doubtful whether pure water can be obtained in this county by artesian wells sunk in the rock. In nearly all parts of the county, however, water can be obtained from the quicksand below the boulder clay, which, in most cases, will rise high enough to be readily pumped to the surface, and in some cases, in the north part of the county, flows out naturally, as in the numerous flowing wells of Iroquois county, which are probably supplied from the same source.

---

*The enormous thickness of this coal, as reported by the well borers, has always been a mystery to the coal miners, since no such bed appears upon the outcrop, and the boring referred to in Major Kirkland's letter did not reach any corresponding bed. It was long suspected that at least a part of this was shale, and the parties who bored an "oil well" at Rock Ford, on Salt Fork, report finding, at a considerable depth (amount not given) below coal No. 7, "twelve feet of black shale and four feet of cannel." If this report is correct, this is probably coal No. 6, the changed condition being only the result of the more complete action of the causes which gave to that seam, two miles above Danville, a top bench of nine inches of cannel. Until, however, some shaft has been sunk to this lower seam at some considerable distance west of the outcrop, I shall not be willing to believe in any such condition of things at that level.

Road Material.—Along Jordan creek, about a mile below Fairmount, several strong springs flow from a heavy bank of very sandy boulder-clay, which is said to harden rapidly when exposed to the air. It would be worth while to try the effect of a good coating of this upon some of the prairie-roads, making the application when the road is dry and smooth.

In working up the geology of this county, I have met with most cordial treatment everywhere; but can only express my great indebtedness to Dr. J. C. Winslow, of Danville, who, since the day I commenced work in the county, has done all in his power to forward my plans, and both during my stay there and since my departure, has constantly furnished me with needed information and specimens. The exigencies of the survey required me to extend my lines into the adjoining part of Indiana; and here I received the indefatigable assistance of Mr. John Collett, of Eugene, who, whenever called upon, has been always ready to put himself and all he possessed entirely at my disposal. I could wish no geologist better fortune than to fall into his hands. In this part of my work, I was also very greatly assisted by Mr. William Gibson, of Perrysville, and Dr. C. P. Boyer, of Williamsport.

NOTE.—The coal No. 6 or "Grape creek seam" of this county seems to correspond much better in its general characters with No. 6 of the Illinois valley section, than the Danville coal, which Mr. Bradley suggests as its probable equivalent. Everywhere in Fulton and Peoria counties, where No. 6 has been examined, it has a clay parting, usually a little below the middle of the seam, and varying from a half inch to two inches or more in width. The coal is also very free from pyrite, and is usually preferred for blacksmiths' use, and has a well defined "block" character. We see no objection to considering No. 7 in the Wabash valley as the equivalent of some of the thinner seams above No. 6, in the Illinois river section, which are there too thin to be of any value practically, and hence have been but slightly studied, and consequently their peculiar features are as yet but little known. So far as the specific character of the fossils of the roof shales can be relied on to determine the equivalency of the strata, there is a much closer resemblance between those found in connection with the Danville coal and the small seam outcropping in the vicinity of Springfield (which must be as high in the series as Nos. 8 or 9 in the Illinois valley section), than with any of the lower seams. A. H. W.

CHAPTER XVII.

EDGAR, FORD AND CHAMPAIGN COUNTIES.

Edgar county lies adjacent to the eastern part of the State, and is bounded on the north by Vermilion county, on the west by Coles county, and on the south by Clark county. It is nearly a square, being about twenty-three and a half miles long by about twenty-seven miles wide, and thus containing something less than six hundred and forty square miles.

The eastern and southern borders of the county, comprising perhaps two-fifths of its area, are occupied by the timbered land adjoining the breaks of the streams which run toward the Wabash. The remainder, with the exception of a few sections about the head of Embarras river, in the western edge of the county, is occupied by the Grand Prairie, some arms of which also run quite deeply into the timber, along the divides between the different creeks.

The timber is mainly the same as that of the timbered lands to the northward; but in the southeastern part of the county, beech begins to take a prominent place, and considerable numbers of pines find congenial soil above the heavy-bedded sandstones which form the bluffs of the Barren Fork and its branches, in the edge of Clark county, south of Grandview.

The prairie generally has a deep black mucky soil, but, in some of its eastern extensions into the timber, this is mostly wanting, and the soft dark brown clay of the subsoil comes nearly to the surface. The bottoms of the prairie sloughs generally contain more or less light brown marly clay containing fresh water shells. From one of these slough bottoms, a nearly perfect skeleton of a Mastodon was obtained some years since, which, after having been exhibited through all this part of the United States, is said to have been sold to a Philadelphia museum. Fragments of skeletons of this animal are not rare hereabouts.

The beds of the Drift period do not show any very great thickness in this county, and only the boulder-clay member is well developed. They may perhaps attain a depth of one hundred feet in the northern part of the county. Where any considerable quantities of these materials occur, they are generally underlaid by a heavy bed of water-bearing quicksand, apparently continuous with that found in Champaign and Vermilion counties in the same position. This was encountered at Grandview, in 1869, at a depth of fifty feet, in the shaft attempted by Messrs. Holding in search of coal.

Rock Formations.

The rocks exposed within the county all belong to that portion of the Coal Measures which lies above coal No. 6 of the Illinois valley section, or No. 7 of the Wabash valley section, as given in the report upon Vermilion county. Above that level, no workable seam of coal is developed in this region. Immediately upon the borders of the county, however, we find the outcrop of No. 7 and No. 6 is not far below. Both seams are probably workable by shafts in all parts of the county. For the readiest understanding of the geology of the county, I give the following general section:

		FEET.		
1.	Soft clay shales			40
2.	Coarse sandrock and shales, with limestone bands			95
3.	Limestone, bottom often shaly			25
4.	Green, dark drab and black clay shale (level of "No. 12 ?")	3	to	4
5.	Greenish shaly sandstone and sandy shales	12	"	15
6.	Green and drab clay shales	30	"	40
7.	Light drab and greenish, very ferruginous sandy shales	15	"	20
8	Dark drab clay shale, with few large ironstones	5	"	6
9.	Impure shaly coal, "No. 9 ?"			1½
10.	Greenish clay shales	8	"	10
11.	Sandy argillaceous limestone, containing pebbles of black limestone, and fragments of fossils	1½	"	3
12.	Red and green, changing to green sandy shales and shaly sandstones, locally heavy-bedded, containing *Caulerpites*, and graduating below into	10	"	15
13.	Green and drab clay shales, with ironstones very numerous at bottom	30	"	35
14.	Marly argillaceous limestone, with fossils	1-6	"	½
15.	Soft black shale			2
16.	Coal, "No. 8 ?"	1-6	"	½
17.	Fire-clay	3	"	4
18.	Light drab sandy shales, weathering greenish, with heavy ironstones	40	"	50
19.	Dark drab sandy shales, weathering greenish, coarsely concretionary	12	"	15
20.	Light blue clay shales	15	"	20
21.	Coal, top shaly, "No. 7"	5	"	6
22.	Fire-clay	6	"	8
23.	Sandy shales	10	"	12
24.	Limestone	1	"	2
25.	Sandy shales	8	"	12
26.	Compact sandstone	3	"	6
27.	Greenish sandy shale, with few ironstones	25	"	30
28.	Black shale, some slaty, with very heavy pyritous ironstone nodules	5	"	6
29.	Coal, "No. 6"	5	"	6
30.	Fire-clay and soft clay shale	4	"	6

Nos. 1 and 2 of this section are here given in general terms from the report of the boring at Sutherland's distillery, two miles north of Paris. The outcrop of the corresponding beds on Sugar creek, the only point where they were seen, is so disconnected that a detailed section can not be made. With the exception of the limestone bands of No. 2, of which I can find no trace along the outcrop, I am inclined to accept them as generally correct. Apparently belonging near the top of No. 2, I found, at two or three points, about three inches of shaly coal, overlaid by from one to two feet of black, slaty shale, with pyritous nodules apparently of coprolitic origin, though no fossils were seen. Of the shaly sandstone next beneath these beds, several layers will yield very fair sized flag-stones, though they do not appear very durable. The coal must represent seam "No. 13," according to the numbering adopted in these reports for the Wabash valley coals.

The bed of limestone numbered 3 in the section, was reported as being twenty-five feet thick in the boring. The best outcrop seen is at the Roman Catholic church, one mile east of Baldwinsville, where a small stream runs over and exposes twelve or fifteen feet of its lower layers. These are partly compact, partly shaly, and, near the base, contain several thin layers of green, shaly clay. Fossils are tolerably abundant, but only of the most common species. The higher layers of this bed are more solid, and have been quarried for culverts and foundations at several points near the southeast corner of township 14 north, range 11 west. The lower layers have been quarried, to a small extent, near Mr. Clinton's, on Lane's branch, in the northeast quarter of section 5, township 13 north, range 11 west. They are here also quite thin and with shaly partings, and contain great numbers of fine fossils, such as *Athyris subtilita*, *Spirifer cameratus*, *S. lineatus*, *Meekella striato-costata*, *Pleurotomaria turbiniformis*, *Cyathaxonia prolifera*, *Heliophyllum?* plates and spines of *Palæchinus*, etc. On the main branch of Sugar creek, there is no exposed outcrop of this bed, though the large masses of it lying in the bed of the stream, a short distance above the railroad bridge, may be considered as indications that the bed is not far off. Tumbling masses of this rock are also seen in considerable numbers just at the county line on Big creek, but no outcrop was detected in this neighborhood.

On Barren fork of Big creek, at the Big creek mill, in the southwest quarter of section 1, township 12 north, range 13 west, the same bed outcrops, with nearly the same fossils as on Lane's branch. Not more than ten feet of the lower shaly portion of the bed is here exposed. In descending this fork, we come to shaly sandstones, which, near the county line, and especially in the neighboring part of Clark county, give place to very heavy bedded sandstones, forming abrupt banks and cliffs of from ten to perhaps forty feet in hight. The connection between these beds and the limestone was not exposed, and the dip was not strongly enough marked to decide their relations; but my impression at the time was, that the limestone was the higher bed. I will not, however, insist upon that interpretation of the facts, since it in no way affects my determination about the overlying beds, and Prof. E. T. Cox, who surveyed Clark county, though confessing that he nowhere saw the direct connection of the two sets of beds, is very strongly of the opinion that the sandstone is the higher.

From the Roman Catholic church before mentioned, there is an almost continuous outcrop, down Brouillet's creek, as given in the section, until we meet the first workable coal seam just below the State line. A similar section is exposed upon Coal creek, two or three miles farther south, which joins Brouillet's creek at the Indiana furnace. On both these streams, Nos. 13 and 18 furnish large quantities of ironstone nodules of fine quality.

No. 11 of the section, with its numerous pebbles of black, bituminous limestone, furnishes a readily recognizable horizon, for some miles along the creek, near and below Baldwinsville.

No. 12, although quite variable in character within short distances, is noticeable for containing the *Caulerpites marginatus*, which marks the same level along the Salt Fork in Vermilion county.

No. 14 contains a few fossils in good preservation, such as *Spirifer lineatus*, *S. planoconvexus*, *Spiriferina Kentuckensis*, *Pleurotomaria sphærulata*, *P. Grayvillensis*, *Productus longispinus*, *Cyathaxonia prolifera*, *Astartella*, etc.

The coarsely concretionary structure of No. 19 allies it with corresponding beds in Vermilion county, which there lie perhaps thirty feet higher than coal No. 7.

With the exception of the limestone No. 3 of the section, whose distribution has already been spoken of, the small outcrops along the streams in the southern part of the county are so disconnected, and of such common characters, that it would be next to impossible to determine their exact equivalents in the section. On Clear creek, in the northwest quarter of section 7, township 12, range 11 west, a few feet of a soft, fine grained sandstone, somewhat ferruginous, has been quarried to a small extent, principally for grindstones. It is underlaid by four or five feet of very dark drab clay shale. This may be the equivalent of No. 12 of the section, but I am rather inclined to believe that No 7 has here taken the form of a sandstone. In either case, it is not impossible that the report may be correct, that coal was struck at eighty feet, in a boring made in this neighborhood some time since. The shales and irregular shaly sandstones, which outcrop just at the railroad bridge over the main branch of Sugar creek, evidently belong to Nos. 4 and 5 of the section. In going down this creek, we find no beds of rock evidently in place, except about a mile north of Elbridge, where two or three feet of soft, drab clay shale make their appearance at two or three points, but give no indication of their position in the section. Upon the streams west of Big creek, in the southwest corner of the county, and about the head of Embarras river, in the western part of the county, no rock outcrop could be found.

The boring at Sutherland's distillery seems to have been put down at nearly the highest point in the county, geologically speaking; and a carefully prepared record of it would aid very greatly in the determination of the geology of the county. Such a record was kept by Dr. Newell, of Paris, but was unf[illegible]nately lost in the burning of his store, and only general facts have bee[illegible] preserved by memory. It is stated, however, that one hundred and thirty feet [illegible] strata were found between the limestone No. 3 and the first workable coal, and about one hundred feet between this and the next one, below which no coal is reported. It would be queer if none of the lower seams should run under here; but two five-foot seams are enough, for several generations at least.

The following is reported as the section of a boring made at Sandford's Station, in May, 1867:

		FEET.	IN.
1.	Soil and subsoil	15	
2.	Sand	6	
3.	Sand and clay	4	
4.	Hardpan	66	
5.	Brown clay	10	3
6.	Blue clay	8	4
7.	Sandstone		4
8.	Blue clay	37	2
9.	Black shale	1	3
10.	Fire clay	4	5
11.	Limestone	6	5
12.	Red clay	2	
13.	Limestone	3	
14.	Soapstone	2	8
15.	Limestone		9
16.	Red slate	7	6
17.	Hardpan	2	9
18.	Limestone	3	
19.	Sand and clay	4	
20.	Limestone	1	9
21.	Red slate	1	6
22.	Sand and blue clay	5	3
23.	Sandstone	3	10
24.	Black slate	8	3
25.	Hard stone		5
26.	Black slate	4	2
27.	Bastard lime		8
28.	Slate	7	5
29.	Soapstone	5	3
30.	Rotten coal	4	7
31.	Sandstone		6

	FEET.	IN.
32. Fire clay	7	2
33. Sandstone	4	
	239	7

The black shale of No. 9 of this section apparently represents coal "No. 7," while Nos. 24 to 26 may represent coal "No. 6." No 30 may possibly be a parting of "No. 6," locally separated from the same seam. There are spots in every coal seam where the coal is wanting, and this boring, if correctly reported, seems to have been sunk at a point where this is true of both seams. It is possible that the seams do not extend under the southern part of Edgar county; but I do not believe this to be true. I put no faith in the reports of the sections obtained in sinking several oil wells in the northwest corner of Clark county and the southeast corner of Coles county, most of which, as reported, contain no coal. I judge that coal can be found under every section of the county, at a depth nowhere exceeding three hundred and fifty feet; and, along the line of the railroad, two hundred and fifty feet would probably reach the first seam of coal "No. 7," in nearly every case; the most doubtful point being at Paris. The distance from "No. 7" to "No. 6," is reported at one hundred feet in the distillery boring; but this distance is probably about seventy feet on Brouillet's creek, and less elsewhere. "No. 7" is quite impure in all this region, and, in shafting for coal, it would probably be best to go on to the lower seam, No. 6, which is a much purer article, considerable portions of it being the so-called "block" coal, in most of its outcrops in this region. In consequence of the great variations in thickness in most of the beds exposed along Brouillet's creek, I have been obliged to give, in the general section, very variable thicknesses for nearly every bed. In calculating from the section the probable depth to any particular bed, at any one point, the average of thicknesses should be used. I had hoped that, before the publication of this report, at least one shaft might have been sunk, so as to determine the exact section at some one point, but the shaft proposed at Paris is apparently given up, and the one commenced at Grandview, by Holding Bros., has been temporarily stopped, through meeting with the heavy beds of water-bearing quicksand at the base of the boulder clay.

One kiln of lime was burned at Collins's quarry, on Lane's branch, but care was not taken to separate the shaly layers before burning, and the lime is worthless, except for agricultural purposes. Some portions of the bed No. 3 of the section, would make good lime.

For courtesies and information, while engaged in the survey of this county, I am especially indebted to John W. Blackburn, Esq., and to Dr. Newell, both of Paris.

CHAMPAIGN AND FORD COUNTIES.

These counties occupy a nearly central position in the State, measuring north and south, and lie in the second tier of counties from the Indiana line. They are near the center of the Grand Prairie, and have an almost exclusively prairie surface. The groves are few and small, and are situated upon the small streams which head in these counties.

Champaign county contains about ten hundred and eight square miles, being about thirty-six miles from north to south, and about twenty-seven from east to west.

Ford county consists of two parts, the one adjoining Champaign county, about fifteen miles from north to south, and twenty-seven miles from east to west; the other, running thirty miles northward, between Iroquois and Livingston counties, to the south line of Kankakee county, with a width of only six miles.

So far as is known, there is no outcrop of rock within the limits of these counties. Scattered over their area, there are many large drifted masses of Niagara group limestone, and Coal Measure limestone, and sandstone. These are, in some cases, of very large dimensions, and have yielded considerable quantities of stone for local use; so that some persons have supposed them to be solid beds of rock. The evidence is, however, as we have stated, that no solid bed reaches the surface.

The soil is mainly the rich black prairie muck, from one to five feet thick, underlaid, in most cases, by a yellow clay subsoil. Along the sloughs and ponds, the subsoil is a tough brown to yellow clay, with numerous small fresh water shells of the genera *Physa*, *Limnea*, *Planorbis*, *Cyclas*, etc. These are often so numerous as to give a whitish cast to the whole mass. We have not heard of the finding of any Mastodon remains in these beds, though they are not rare in similar situations in adjoining counties.

The subsoil is underlaid by irregular alternating beds of clay, gravel and quicksand of the Drift formation, to the depth of from one hundred and fifty to probably three hundred feet.

In an attempt to sink a coal shaft at Champaign, Mr. John Faulds found the following section:

	FEET.
Soil, clay and quicksand	17
Red and blue clay	73
Peat	2
Quicksand, containing a tree seven inches in diameter	9

	FEET.
Soft yellow clay	9
Sand	3
Yellow clay	7
Quicksand and gravel	59
	179

The bottom bed of quicksand defied all his efforts to reach a greater depth. Within a short distance of this place, however, an earlier boring, of which we have not the data, is said to have reached soft blue shale at one hundred and sixty-eight feet from the surface.

The depth and character of these beds correspond with what is known of similar deposits to the northward and eastward. We find in them evidence that, at some former period, some powerful denuding current has torn up the rocks and excavated a broad and deep channel, extending from the southern end of Lake Michigan, down the eastern line of the State until, shortly after passing the line now occupied by the Kankakee river, it rose over the declining edge of the Niagara limestone, and then bore off southwestward through the softer beds of the Coal Measures, which here seem to lie directly upon the Niagara. This channel passes through the central and western parts of Iroquois county, and includes large parts of Ford, Champaign and McLean counties, with the southeastern part of Livingston, where its western bank must be located between the two borings at Chatsworth, the western, on the southeast quarter of section 4, township 26 north, range 8 east, near the east line of the section, striking the Coal Measure rocks at eighty-eight feet, and the eastern, in the southeast quarter of section 3, of the same township, striking no rock until it reached the green calcareous shales of the Cincinnati group at two hundred feet.

To the westward of Champaign county, its course is not so well indicated; we know only that it runs under Bloomington, in McLean county, with a depth of two hundred and fifty-four feet. However, as we find at Rantoul and Champaign, points probably near the eastern side of the channel, and at Chatsworth, which we know to be on its western bank, only one "dirt bed," or ancient mucky soil, noted as "peat" in the foregoing section, while at Bloomington we find two such beds well developed, one six feet, and the other, thirteen feet thick, I am inclined to believe that this point is near the center of the old valley. I will further suggest that its junction with the valley of the Illinois will probably be found somewhere in Tazewell or in Mason county.

The erosion of this great valley, of course, took place before the beginning of the Drift period, since the deposits of that age not only fill it completely, but deeply cover its banks, except at the few points where they have been removed in the course of the erosion of the present river valleys.

The gravel beds contain the ordinary variety of metamorphic rocks, with not unfrequent larger or smaller masses of galenite from the Galena region, and native copper from Lake Superior; but the larger part of the pebbles and rock masses consist of the Niagara limestone, or "Kankakee stone," and the shales, sandstones and limestones of the Coal Measures.

The sands and gravels of these beds furnish abundant supplies of water at moderate depths; and the white quicksand, lying between them and the underlying rocks, yields inexhaustible quantities, though generally at too great a depth to be readily pumped up.

Underlying Rocks.—The boring above reported as having reached blue shale at one hundred and sixty-eight feet, is said to have encountered, at one hundred and seventy-six feet, a bed of coal five feet thick, which is supposed to be equivalent to the Danville seam, "No. 7." As the synclinal axis of this part of the Coal Measures crosses the Salt Fork of the Big Vermilion river at Conkeytown, five miles east of the east line of Champaign county, with the Danville seam not far from two hundred feet below the surface, while the underlying beds begin to rise slowly as we ascend the river from that point, it seems not improbable that this seam may be found at the depth reported, but its existence there seems still uncertain.

It appears almost certain that the northern strip of Ford county is destitute of coal; but no boring has proved its absence in the southern portion of the county; judging, therefore, from the data obtained in the surrounding region, it seems probable that the whole of this district is underlaid by one or more workable seams of good coal, the uppermost probably lying *nowhere more* than three hundred and fifty feet below the surface, and generally at a much less depth. There appears, therefore, to be no good reason why shafts should not be sunk to furnish a home supply in place of that now transported from a distance. And, as both counties are crossed by the Illinois Central railroad, giving direct connection with Chicago, a ready market could be found for any surplus of this sole source of wealth, aside from those which are strictly agricultural. The heavy bed of quicksand which is said to rest directly upon the rock, under a part, at least, of this district, presents the only obstacle to easy mining; and this could be readily overcome by any engineer of ordinary skill.

It is reported that at Urbana, starting fifty feet lower than the surface at Champaign, coal was encountered at two hundred and twenty-five feet.

Borings made near Rantoul in 1857, whose results were then suppressed, are now said to have found, about a half a mile south of the station, a nine-foot seam of coal at a depth of one hundred and twenty feet, having struck rock at a depth of eighty feet; and one and a half miles east of the station, the same seam at one hundred and sixty feet.

The purity of the white water-bearing quicksand which underlies the Drift, calls to mind the character of the St. Peters sandstone at its outcrop in La-Salle county, in which region it supplies several large artesian wells. The southern continuation of the anticlinal axis, which brings this rock to the surface at that point, would pass not far from Champaign; and it is altogether probable that the aforesaid quicksand is really a part of the disintegrated outcrop of that bed distributed over the bottom of the great channel, which must have exposed it at some point in this region. It is also probable that the water which fills the quicksand comes from the edge of this bed.

CHAPTER XVIII.

HENDERSON COUNTY.

Henderson county is situated on the western border of the State, and embraces a little less than eleven townships, or about three hundred and eighty square miles. It is bounded on the north by Mercer county, on the east by Warren county, on the south by McDonough and Hancock counties, and on the west by the Mississippi river. The surface is much broken by the numerous streams passing through it. The principal one of these is the Henderson river, which enters the county near its northeast corner, and, passing in a southeasterly direction, empties into the Mississippi about six miles below Oquawka. Tributary to the Henderson, and in the northern part of the county, are Fall, and North and South Smith creeks. South Henderson creek enters the county on its eastern border, through the southern part of township 10 north, and running a little to the north of west, empties into the Henderson about a mile north of Sagetown. South of this the county is intersected from east to west by Ellison creek, which empties into the Mississippi about two miles north of Shokokon. In the southern part of the county there are Honey and Dugout creeks.

The prairies of this county are mostly small, and occupy less than half its entire area. The soil of the prairie is a deep, black loam, with a brown clay subsoil. On the ridges, which skirt the streams, the soil is of less depth, and of a lighter color than that of the prairie. It is usually a dark brown, loamy clay, becoming lighter brown on the slopes of the hills, and partaking more of the character of the subsoil. Formerly these ridges were, for the most part, timbered, but much of the timber has been cut off, and the process of denudation still goes on. The timber on these ridges is principally the common varieties of oak and hickory, with an undergrowth of hazel and sumac. Along the slopes of the hills, and on the bottom lands of the streams, we find in addition to these, red and white elm, white, blue and prickly ash, linden, sycamore, sugar and white maple, ash-leaved maple or box-elder, black walnut, butternut, buckeye, cotton wood, honey locust, American aspen, wild cherry, coffee tree, hackberry, mulberry, iron wood, wild plum, thorn, crab-apple, dogwood, and redbud.

Between the bluffs and the Mississippi there is a belt of bottom land extending from the north end of the county to Camp creek, with an average width of from two to three miles. A portion of the soil of this land is a deep black loam, very fertile, and originally covered in part by a heavy growth of timber. Here we find black, white, red and pin-oak, pecan, the common varieties of hickory and elm, buckeye, black walnut, butternut, sycamore, box-elder, etc.

Along this bottom land, and for nearly the entire length of the county, there runs a variable belt of sand ridge. It generally lies in low, rolling ridges, which, in some cases, become hills of thirty or forty feet in hight. This belt passes irregularly through the bottom lands, here forming the river's bank, and there running nearly back to the bluff. In the northern part of the county it, in some places, attains a width of about two miles. The soil is mostly poor; still considerable portions of it are cultivated, and by proper manuring, yield moderately, though but few seasons are wet enough for it to produce largely. The timber is principally scrubby, black-jack oak.

Springs are numerous in this county, and some of them are large and valuable, furnishing a constant supply of water, in quantities sufficient for the necessities of large herds of cattle. Good wells may generally be obtained at depths of from fifteen to sixty feet. Mineral springs are not uncommon, copperas being the mineral most commonly held in solution. One of the largest and best known of these is in section 32, townsphip 11, range 4 west.

Surface Geology.

The surface deposits of this county comprise the three sub-divisions of the Quaternary System, Alluvium, Loess and Drift, and attain a thickness of from thirty to eighty feet. The largest alluvial deposit in this county is that along the Mississippi, but smaller belts are found along the smaller streams, especially Henderson river, South Henderson, Ellison and Honey creeks. These, however, are seldom over a half mile in width, and frequently but a few rods. The soil of these deposits is generally largely composed of vegetable mould, mixed with sand and gravel, and is very fertile. That along the Mississippi has been already described.

The Loess is a marly sand deposit, generally more or less calcareous, and usually containing large numbers of fresh water and land shells, mostly of species still existing in this region. It frequently contains small concretions of carbonate of lime, which have resulted from the leaching of the mass These were noticed in township 9, range 5 west. This deposit caps a portion of the Mississippi bluffs in this county, and is also found along South Henderson and Honey creeks. Elsewhere it was not noticed, though it is probable that it may be found in other parts.

The Drift comprises a series of brown, yellow and blue clays, locally intermingled with sand and gravel, with, in some places, thin beds of cemented gravel. These deposits are spread over the entire surface of the uplands, and when the Loess is present, underlie it. Bituminous coal in rounded fragments, is frequently found in the Drift, and has been derived from the coal strata in the adjoining region. From these fragments, many have been led to suppose that valuable beds of coal might be found where they occur, and much time and money have been wasted in searching for them. They do not furnish any evidence, however, of deposits of coal in the immediate vicinity in which they occur. In section 23, township 8, range 6 west, just above the bridge, where the bluff road crosses Dugout creek, considerable quantities of drift coal has been observed. It is reported that, at one time, a sufficient quantity was obtained here to be used for blacksmithing purposes.

The other geological formations that occur in Henderson county are the Coal Measures, St. Louis group, Keokuk Limestone, Burlington Limestone, and Kinderhook group.

The *Coal Measures* are found only in the southeastern part of the county They are represented by a few thin beds of sandstone, shales, clays, and a single seam of coal, which has been found only in sections 23 and 26, township 9, range 4 west. It probably belongs to coal No. 2 ? of the Illinois river section, and at this point varies from one foot eight inches to two feet ten inches in thickness. In the south part of section 23 it is overlaid by a yellow sandstone mottled with whitish spots, which appears to be unfossiliferous. At the other mine, in the northeast quarter of section 26, this sandstone contains pebbles and fragments of carbonized coal plants, while in some parts of it there are nodules of fossiliferous limestone. Among the fossils obtained here are *Spirifer planoconvexa*, *Athyris subtilita*, *A. Royissii*, *Rhynchonella Osagensis*, *Retzia punctilifera* and *Terebratula bovidens*. The coal rests upon a bed of fire-clay, the thickness of which has not been ascertained. At this point the strata dip, at a slight angle, to the southwest, while in section 23 they dip to the northeast.

Sandstones resembling those of the Coal Measures have been found in various parts of townships 8 and 9, range 4 west, also near Biggsville. Thin outliers of the Coal Measure strata may also be present in other parts of the county, but deeply buried beneath the Drift, and would probably afford no coal of any value, if found. Where the Drift is known to rest on the Sub-carboniferous limestone, the search for coal would be useless.

St. Louis Group.—Beds belonging to this group have been recognized with certainty only along South Henderson creek, near Biggsville. At the time I visited this place (in the spring of 1868), the creek was so high that many of the beds were covered, and others could be examined only with much difficulty. I am indebted to Prof. A. H. Worthen for the following section, which was made by him about a mile and a half southeast of Biggsville:

		FEET.
1.	Loess	10 to 12
2.	Gravel, sand and clay	12 " 15
3.	Blue plastic clay, with pebbles	15
4.	Quartzose sandstone	2
5.	Band of broken, rotten limestone	1
6.	Blue marly clay, stratified	15 " 20
7.	Band of broken magnesian limestone	1½
8.	Keokuk beds	25 " 30

No. 4 of the section probably belongs to the Coal Measures, while Nos. 5, 6 and 7 belong to the St. Louis group. West of Biggsville it was again recognized in section 17. Commencing below the Drift, a section of the strata gave the following:

		FEET.	IN.
1.	Shale and yellow clay		10
2.	Soft, yellow sandstone		10
3.	Blue clay shale	2	
4.	Keokuk beds (not measured)		

Nos. 1, 2 and 3 of this section belong to the St. Louis group. South of this, along Ellison creek, thin outliers may exist, but none were recognized.

Keokuk Limestone.—This division of the Sub-carboniferous series is found along the southern line of the county, at and near Dallas City. It rises to the north or northeast, and on going up the bluff road about a mile, it disappears, having either run out, or is so deeply covered by the Drift as not to be exposed along the streams. East of Dallas City this limestone appears, forming the bluffs of Camp creek, but on going down the creek, northwest, it soon runs out, and the lower layers exposed are Burlington limestone. The Keokuk beds again appear in section 11, township 9, range 4. A section at this point is as follows:

		FEET.	IN.
1.	Soil and Drift (not measured)		
2.	Yellow clay shale, containing a few geodes	1 to 2	
3.	Limestone	3	2
4.	Blue clay shale	?	

North of this it is again exposed on South Henderson creek. Its most westerly outcrop along this stream, is about two miles east of Sagetown, in section 13, township 10, range 5. Here it appears near the top of the bluff, and a mile or two up the stream it forms the bed of the creek. Its most easterly exposure is about three miles southeast of Biggsville, in section 26, township 10, range 4. A short distance west of Biggsville, in section 17, the rocks exposed in the creek bluff gave the following section:

		FEET.	IN.
1.	Soil and Drift. Not measured.		
2.	Sandstone, soft	1	5
3.	Yellow clay shale	1	7
4.	Bluish clay shale	6	6
5.	Limestone	4	6
6.	Shale	2	2
7.	Limestone	2	11
8.	Clay		2
9.	Shale		4
10.	Limestone		5
11.	Shale	1	1
12.	Limestone		6
13.	Shale	2	1
14.	Limestone		11
15.	Shale, with a little thin-bedded limestone	2	5
16.	Argillaceous limestone	4	2
17.	Limestone and a little shale	1	8
18.	Shale		11
19.	Limestone	3	
20.	Shale		9
21.	Limestone	1	
22.	Thin-bedded limestone, with chert		5
23.	Limestone, a little cherty	1	
24.	Chert		4
25.	Limestone	2	1
26.	Shale, with thin layers of limestone		7
27.	Limestone, very cherty, to the water		8
		39	2

All below No. 4 belongs to the Keokuk. The thickness of these strata are quite variable, but this section serves to give a general idea of their lithological character in this region. Some idea of their variableness may be had from the following section, made at Shoemaker's quarry, which is but a short distance from this point:

		FEET.	IN.
1.	St. Louis beds	3	8
2.	Limestone	2	7
3.	Shale	1	9
4.	Limestone, very shaly		8
5.	Limestone	2	11
6.	Shale		7
7.	Limestone	?	

Lower than this, the quarry was not worked, and the rock was not exposed. This quarry lies near the top of the bluff, and corresponds very nearly with the upper part of the other section. North of the immediate vicinity of the South Henderson, this limestone is not exposed, and probably thins out rapidly in that direction, as the Burlington limestone appears but a few miles north of this on South Smith creek.

Fossils.—The beds of this limestone that are found in this county, though not as rich in organic remains as at other localities, furnish some interesting specimens. They seem to have been deposited in a quiet ocean, where the beautiful crinoid and the delicate bryozoan abounded, and considerable portions of the limestone are thickly covered with the finely preserved skeletons of these organic forms. Indeed, these waters must have teemed with animal life, for not only the shales are full of their remains, but the solid limestone itself is largely composed of them. Numerous fish swam these seas in those early days, as the teeth and spines they have left, as a record, abundantly testify.

Among the fossils most common in this limestone, are the following: *Spirifer neglectus. S. Keokuk, S. lineatus, Hemipronites crenistria, Productus Wortheni, P. punctatus, Zaphrentis Dalii,* and an undescribed *Chætetes.* Of the crinoidea most worthy of mention, is the *Barycrinus magnificus.* Nearly all the plates of a full grown individual, together with a portion of the arms and stem, I obtained near Biggsville. It is supposed to be the largest crinoid yet found in this State.

Burlington Limestone.—This formation, which underlies the Keokuk limestone, outcrops near Dallas City, in section 36, township 8, range 7, along the river bank. The quarries lie but little above the river, and are overflowed at high water. Higher up in the bluff, the Keokuk beds appear. Proceeding along the bluff road, there is an outcrop of the Burlington beds, near the dividing line between sections 28 and 29, township 8, range 6. Northeast of this, in sections 22 and 23, the rock again appears, and is quarried. South and east of here, there are exposures of the rock in sections 24, 25 and 26; also in sections 29 and 30, of township 8, range 5, along Dugout creek and its tributaries. Numbers of the more common crinoids were found at these localities. The rock here is considerably cherty, and much of it thin bedded. The thin layers, when freed from chert, furnish good material for lime, and at most of the openings there are one or more layers, a foot or so thick, that afford good building stone.

Between Dugout and Honey creeks, there are no outcrops in the bluff, but they commence along the latter stream, in section 12, township 8, range 6. Higher up the creek, we find outcrops in abundance for six or eight miles. Quarries have been opened in sections 1, 4 and 18, township 8, range 5; also in section 6, township 8, range 4. The rock has been more extensively worked here than on Dugout creek, and the layers are generally thicker. Blocks of any desirable size, from one to two or three feet thick, may be had. Some of the layers are of a yellowish-brown color, others are tinged with blue, while others are nearly white, or of a light, creamy gray.

Much assistance was rendered me by Messrs. D. Edmonds, Jas. Peasley and M. Nolan, while examining this region.

North of this, there are no exposures in the bluffs for several miles. Along Ellison creek, the rock does not appear till we reach the east part of township 9, range 4, but it crops out in several places on some of its branches. It has been worked in sections 23 and 25, township 9, range 5; also in sections 9, 20, 21 and 29, township 9, range 4. In the bluffs of North Ellison, section 13, and of main Ellison, section 24, of the latter township, there are extensive and valuable quarries. These have been worked for a long time, and have furnished an immense amount of stone, both for lime and for building. Most of the strata here are sufficiently thick for any ordinary use. Section 13 affords an excellent article of building stone, the most of which is light colored. That from section 24, is largely of a yellowish or reddish brown, but otherwise of good quality. Some of the layers are more or less arenaceous. The following section was made here:

		FEET.
1.	Drift	10 to 30
2.	Limestone, with some layers of sandstone too little exposed to be separately measured	24
3.	Shales of the Kinderhook group	?

The quarries on these two sections furnish the principal supply of building stone to the surrounding region for some distance, especially to the south and east. At these localities, fossils are quite abundant, especially crinoids.

At this place there is a dip of from 2° to 3° to the north or northeast. This inclination carries the beds of the Burlington below the surface, and probably continues to a point near Biggsville, from whence they rise towards the north, thus forming a shallow synclinal. At Biggsville, some forty or more feet of the St. Louis and Keokuk group, overlie the Burlington. The first outcrop of the Burlington to the north, that was observed, was a little to the north of the centre of section 32, township 11, range 4.

West of this, the first exposure of importance is along the Mississippi bluff, in section 15, township 10, range 5. A short distance east of Sagetown, on the Chicago and Burlington branch of the C., B. and Q. railroad, there are extensive quarries owned and worked by A. Wallbaum, Esq. Work was commenced here in 1861. The quarries lie along South Henderson creek, one on either side, and to each there is a side track from the railroad. A section from the highest point in the openings to the level of the railroad track, gave the following section:

		FEET.	IN.
1.	Drift	20 to 25	
2.	Chert and clay in irregular layers	10	4
3.	Limestone and chert in thin layers	21	10
4.	Limestone, mostly good, but in places a little cherty	18	10
5.	Soft sandstone	9	
6.	Chert		8

Some of the lower layers of the heavy limestone beds furnish a beautiful stone of a light brown or yellowish tint, that dresses well. This is largely used for window caps, sills, etc. Large quantities of rock are sent from here by the railroad into Warren, Knox and Peoria counties. The material for the second class masonry of the Burlington railroad bridge, crossing the Mississippi, was from these quarries; the rest of the material coming from Joliet.

Northeast of Sagetown, in section 10, there are outcrops which furnish considerable quantities of stone, both for lime and building purposes. Farther up the bluff, and along the Henderson river, the rock has been worked in section 2, of the same township; also, sections 35, 25 and 24, township 11, range 5. In section 25, at Mr. Bosler's quarry, I obtained the following section:

		FEET.	IN.
1.	Slope, with outcrops of limestone	?	
2.	Limestone	3	
3.	Sandstone and chert	1	3
4.	Limestone	6	4
5.	Arenaceous limestone		4
6.	Limestone		10
7.	Shaly limestone and sandstone, with chert	6	3
8.	Calcareous sandstone, with chert	1	3
9.	Shaly limestone		6
10.	Chert		6
11.	Limestone		8
12.	Chert and shaly limestone	8	2
13.	Limestone		6
14.	Shaly limestone and sandstone, with chert	3	
15.	Limestone	1	6
16.	Chert		11
17.	Slope, with outcrop of limestone	15	

In the northeast quarter of section 25 there are extensive outcrops. At this point, on the farm of Mr. Jenks, there is a crevice in the rocks known as Jenks' cave. A portion of it has been destroyed in quarrying the rock, but for ten or fifteen feet from the entrance it is from six to nine feet high, when it suddenly becomes smaller. It has been penetrated about seventy-five feet.

Along North Smith creek the beds of the Burlington limestone form extensive ledges. Some of the lower and softer layers having been worn away by the combined action of the atmosphere and the water, the upper layers are frequently left projecting, in some cases, quite a number of feet. Quarries have been opened in these ledges, at convenient points, in sections 19, 20 and 21, township 11, range 4. Considerable of the rock at these quarries has a yellow or reddish brown color, other portions are light-colored, and make a very pretty building material. In section 19, on the north side of the creek, where the Drift had been removed so as to expose the upper surface of the rocks, they presented that peculiar ground, and striated appearance, commonly referred to the action of glaciers.

North of this there are no outcrops till we reach the southwest quarter of section 8. In section 5, on the Malay and Russ branches, the rock again appears. The most extensive quarry in this section is in the southwest quarter, on the farm of Mr. Malay. An abundant supply of good building material can be had here.

Along Fall creek, there are exposures for two or three miles from its mouth. The rock has been most extensively worked in the north part of section 4. It is light-colored and compact. In township 12, range 4, sections 27 and 28, there are other outcrops of these beds. The strata as exposed here, commencing below the drift, gave—

	FEET.
1. Thin-bedded sandstone	2
2. Limestone, containing thin beds of clay, and towards the top some chert	12

Some of the less common crinoids were comparatively abundant at this locality, and the rock here is mostly thick-bedded, light-colored, and when free from chert, it makes good lime.

The most northerly exposure of the Burlington is in section 18, on the west and northwest sides of Bald bluff. Only about twenty feet are to be seen at this point, and the whole mass is thin-bedded, seldom over a foot in thickness, and is composed of brown arenaceous limestone and sandstone. Bald bluff is a little over two hundred feet high. From here the bluff runs back for several miles in nearly an easterly direction. The Burlington limestone, though not exposed north of here, may exist in the bluffs for some distance, where it probably thins out.

Fossils.—The beds of this limestone exposed in Henderson county probably belong, for the most part, to the upper Burlington division of the group, for at nearly every outcrop I obtained more or less crinoids, all of which have been identified as belonging to the upper Burlington. These beds are exceedingly rich in fossils, particularly crinoidea. Along the northern shores of the lower carboniferous ocean these "stone lilys" flourished in much greater profusion than in any other known region; and nowhere else have their remains been found in such abundance, or so finely preserved, as in this rock. Though but part of the beds are found in this county, many species have been already obtained, and new ones are still being found. Other fossils, though not as numerous, are abundant, particularly brachiopods. Bryozoa are also found here, but not as abundantly as in the Keokuk rocks. Teeth and spines of fish are not uncommon.

Among the crinoids found are *Actinocrinus multiradiatus*, *A. asterius*, *Batocrinus rotundus*, *B. oblatus*, *B. Christyi*, *B. æquibrachiatus*, *B. pyriformis*, *B. Verneuilianus*, *B. Nashvillæ*. *B. Konincki*, *B. Hageri*, *Strotocrinus ægilops*, *S. liratus*. *S.*

umbrosus, *S. subventricosus*, *S. glyptus*, *Dorycrinus cornigerus*, *D. dicornis*, *Steganocrinus pentagonus*, *Platycrinus plenus*, *Zeacrinus*, species nearly allied to *Z. elegans*, *Codaster stelliformis*, *Granatocrinus Norwoodi*, *G. Sayi* and *Pentremites elongatus*. In addition to these, the following species of brachiopods were obtained: *Spirifer plenus*, *S. Grimesi*, *Productus semireticulatus*, var., *Burlingtonensis*, *Chonetes Illinoiensis*, *Orthis Swallovi*, *O. Michelini;* and of other divisions, *Platyceras*, *Metoptoma umbella*, *Evactinopora sexradiata* and *Hadrophyllum glans*. This is not a complete list of the fossils of this group found in this county, but comprises the most common forms.

Kinderhook Group.—This group, which underlies the Burlington limestone, is exposed in but few places in Henderson county. Across the river, at Burlington, the beds of the group comprise variable strata of shales, gritstones and oolitic limestone. On this side, the oolitic limestone and gritstone beds are wanting, and the group is represented by shales only, which are commonly argillaceous, though occasionally calcareous or arenaceous. The shale is usually in very thin layers, and of little or no value. There is a partial exposure of these beds in section 24, township 9, range 4, along Ellison creek, which gives the following succession, commencing below the Drift:

	FEET.
Burlington limestone	24
Shales of Kinderhook, to the surface of the stream	22

These beds outcrop for some distance along the Mississippi bluffs, but are mostly hidden by the talus of the sloping hills. A short distance southeast of Sagetown, a boring was made a few years since, for the purpose of obtaining water for a distillery. I am indebted to Squire Rice, of Sagetown, who had the work done, for the following section:

		FEET.	IN.
1.	Chert and clay	40	
2.	Bluish clay shale	120	
3.	Black slate		7
4.	Bluish clay shale	162	
		322	7

Considerable of the shale was calcareous, but did not, at any point, become limestone. At a depth of three hundred and twenty-two feet, the character of the rock had not changed, and the work was abandoned, for the time, without having obtained water. This work was commenced in the Drift at or near the base of the Burlington limestone.

Southeast of Oquawka, these shales are exposed on Mr. Bosler's farm, at a little run, about twenty feet above the bed of Henderson river. Along South Smith creek, section 24, township 11, range 5, fifteen feet of these beds may be seen between the Burlington limestone and the creek bottom. At this locality, there is a band of calcareous clay shale, from six to ten inches thick, just below the limestone. These shales, where exposed, seem to be destitute of fossils, none having been found, after a close examination.

Economical Geology.

Building Stone.—Henderson county has an abundant, though not evenly distributed, supply of building stone. The Burlington limestone, which outcrops nearly from one end of the county to the other, along the bluffs of the Mississippi, and also on the larger streams, will afford much the greater part of this supply. The rock is principally a light colored, massive, crinoidal limestone, which is but little affected by the weather. The prevailing color is a light bluish or yellowish gray. In some localities, a portion of the strata contains considerable oxyd of iron, which gives the stone a much darker brownish color. It is tolerably even bedded, in strata from six inches to two feet or more in thickness, and can be easily and cheaply quarried. A few good farmhouses have already been built in this county from this material, and, as wealth increases, it will probably come into more general use as a building stone.

The Burlington beds have been most extensively worked in the eastern part of the county, especially on Ellison creek and its branches, and near Sagetown. Of the quarries near the latter place, the most important are those of A. Wallbaum, Esq. These have been opened about eight years, and at present are extensively worked, a large number of hands being employed. Many of the culverts and the abutments of the bridges of the Chicago, Burlington and Quincy railroad are built of material obtained here. Large quantities of rock are now quarried here, and sent out of the county by this railroad.

The Keokuk limestone furnishes the balance of the building stone for this county. It is generally even textured, dresses well, and affords strata sufficiently thick for all the ordinary purposes for which building stone is required. It is exposed in the southwest part of the county, where it has been worked to some extent, but the strata rise to the north, and soon run out, and are not again visible till just north of Ellison creek, in township 9, range 4. Its greatest exposure is at and near Biggsville. Just west of town, in the bluffs of the south Henderson, there is a partial exposure of these beds of from twenty-five to thirty feet in thickness, a section of which has already been given.

Limestone for Lime.—The largest supply, and the best material for the manufacture of quicklime, is furnished by the limestone beds of the Burlington group. At nearly all the exposures, rock suitable for this purpose can be had. The light colored layers are nearly a pure carbonate of lime. At some localities, the quality of the rock is much injured by the quantity of cherty nodules present, which have to be removed before it is burned. The beds of the Keokuk also furnish considerable material for this purpose, which, when carefully selected, make good lime. The supply of stone, both for building and for lime, is inexhaustible.

The cherty nodules, so common in both the Keokuk and Burlington beds, while worthless for other uses, make a most excellent material for macadamizing roads, and for this purpose, are much more valuable than the limestone.

Coal.—The supply of this useful mineral in this county, is very limited. It is confined to one thin seam which has been found only in sections 23 and 26, township 9, range 4. But little coal has been mined at either opening, and what has been taken out, is reported to be of inferior quality. It is quite likely that this seam may be found extending from here to the south line of the county, at least in places, but probably does not extend much to the westward, unless it be in the northern part of township 8, range 4. Under the most favorable circumstances, the amount that can be obtained from this seam in this county will be comparatively small, and the inhabitants will have to depend mostly upon more favored localities for their supplies of coal. Along the line of the railroad it may be obtained, at reasonable rates, from the coal region to the east.

Other Minerals.—Clay, for brick-making, may be obtained from the subsoil of the uplands, at convenient points, throughout the county.

Iron Ore.—The variety called limonite, was noticed at several localities, but not in sufficient quantities to be of any importance.

Sulphuret of zinc, or *Sphalerite*, is of frequent occurrence in the geodiferous or concretionary masses of the Keokuk limestone.

Crystals of calcite, (carbonate of lime) are found in the different limestone beds lining small cavities.

Soil and Agricultural Products.—The prairie soil is a dark colored loam, everywhere productive where properly drained and cultivated. It contains a large amount of humus, which has resulted from the growth and decay of animal and vegetable matter upon the surface for untold ages. The soil of the timber lands or "oak barrens," is a clay loam, frequently containing but a small percentage of humus, and partaking largely of the nature of the subsoil, which usually lies but a few inches below the surface. The timber found upon these lands is principally red, black and white oak, and shell-bark and bitternut hickory. Along the slopes, the soil is usually much richer and darker colored, except near the top, where it has been nearly or quite washed away, and the subsoil appears. Here the timber is much more varied than on the ridges, and we find the common varieties of oak, hickory and elm, sugar and white maple, linden, wild cherry, black walnut, butternut, red-bud, and several other kinds. Wild grapes are abundant, and would seem to indicate, from the luxuriance of their growth, that they had found a soil adapted to their wants. A few vineyards have been started along the bluffs and on the uplands, which appear to be doing well. The finest orchards in the county are found along these bluff lands, which are much better adapted to fruit growing than those of the prairie.

CHAPTER XIX.

WARREN COUNTY.

Warren county contains fifteen townships, or five hundred and forty square miles, and is bounded on the north by Mercer, on the east by Knox and Fulton, on the south by McDonough, and on the west by Henderson counties. The fourth principal meridian passes along its eastern border, and it embraces townships 8, 9, 10, 11 and 12 north, of ranges 1, 2 and 3 west. It is intersected in the northern part, from east to west, by Main Henderson and Cedar creeks. South of this, there is South Henderson creek, which rises in township 10, range 2, and runs nearly west; while to the east, Slug Run rises in the northern part of township 10, range 1, and passing south, empties into Cedar fork, near the eastern line of the county. Cedar fork rises near the western boundary of township 9, range 2, and runs a little to the south of east; south of this is Nigger creek, of which Little Nigger and Swan creeks are branches. By these and a number of smaller streams, the county is well watered, and its surface thoroughly drained.

Springs are not very abundant, but there are some which are large and valuable. Good wells may usually be obtained at depths varying from ten to thirty feet, but if, at the latter depth, water is not obtained, it is generally necessary to dig sixty feet or more, or through the blue clay of the Drift.

The larger part of Warren county is prairie, but the prairies are seldom large, being divided by the numerous streams. The soil is a dark colored vegetable loam, differing but little, in its general character and appearance, from that of the adjoining counties. Along the ridges that skirt the streams, the soil is of less depth, lighter colored and less fertile. The subsoil is a yellow or brown clay.

Much of the land lying along the water courses, was originally covered with timber. Large portions of this have been cut off, and the work is still continued. The varieties of timber found here are nearly the same as in Henderson county.

Surface Geology.

Two of the subdivisions of the Quaternary system, viz., the Alluvium and Drift, are found in this county. The alluvial deposits are not extensive, being confined to the borders of the streams, and are seldom over half a mile in width, while commonly they are much less. The soil of these bottom lands is very fertile, and consists of black loam, more or less mixed with sand and gravel.

The Drift covers the whole surface of the uplands to a depth of from ten to eighty feet or more. These deposits comprise a series of yellow, brown and blue clays, locally intermingled with sand and gravel. In the northwestern part of the county, the Drift rests upon the Kinderhook group and Burlington limestone, but elsewhere, as far as is known, upon the Coal Measures. Loose coal is frequently found in the Drift, but this is no indication that there is any bed of it in the immediate vicinity.

The older geological formations found in this county, are the—

Coal Measures,
Burlington Limestone, and
Kinderhook Group.

The *Coal Measures* underlie nearly the whole of Warren county. Sumner and the northern part of Hale townships, probably embraces the entire district, or nearly so, where they are not found. The Coal Measures comprise, in this county, various strata of shales, sandstones, limestones, clays and coal, and attain a thickness, in some parts, of from one to two hundred feet. These strata rest upon the Burlington limestone, and where this is found near the surface or reached in shafting, no coal need be looked for in deeper explorations. Thus far, the coal mines that have been discovered are, with but one exception, confined to the townships in ranges 1 and 2. There are three workable coal seams found in this county.

The upper seam is from three feet to three feet six inches in thickness, and has been found at but one locality—section 17, township 8, range 2. There is some doubt as to which seam this may be referred, as I was unable to make any measurement of the strata between it and the seam (No. 2) below, but the distance is probably not over forty or fifty feet between them, perhaps less. As the only open bank in this seam was on fire when I was there, an examination could not be made, or any specimens of the coal obtained, but I have learned that the roof is black slate and the floor arenaceous shale. It may be coal No. 3 of the Illinois section, and the coal obtained from it is reported to be of good quality.

The next seam, No. 2 of the Illinois section, is from one foot eight inches to two feet thick, in this county. Elsewhere it attains a thickness of from three to five feet. Though thinner, this seam is more extensively worked than either of the others. It is worked along Cedar creek, on section 19, township 11, range 1, and sections 13, 14, 23 and 24, township 11, range 2. Also, in the latter township, there are other mines along Honey Run and its branches, in sections 25, 35 and 36. The strata were reported by the miners to be, in this neighborhood, as follows:

		FT.	IN.		FT.	IN.
1.	Drift, not measured					
2.	Clay shale ("soapstone")	10		to	20	
3.	Limestone				0	6
4.	Blue clay, shale and black slate	2		to	2	6
5.	Coal, No. 2 of Illinois section	1	8	to	2	3
6.	Fire clay	3		to	8	
7.	Bituminous limestone	2		to	6	
8.	Clay shale				?	
9.	Thin coal				?	

The coal is of good quality, and, though containing some pyrite (the "sulphur" of the miners), it is easily freed from it.

In sections 23 and 26, township 10, range 1, mines have been opened. We again find this seam worked in section 3, township 9, range 1. In this locality there is sometimes two or three inches of cannel coal at the top of the seam. South of this, in township 8, range 1, there are mines in sections 23 and 26. Though the coal here is but one foot six inches thick, large amounts of superior coal are taken from these mines.

From the bluffs of Nigger creek, sections 14 and 23, the following section was obtained, which gives a general idea of how the strata lie in this region:

		FT.	IN.		FT.	IN.
1.	Clay shale				8	
2.	Coal, No. 2 of the Illinois section				1	6
3.	Fire clay				3	
4.	Clay shale				1	
5.	Coal and black slate					8
6.	Clay shale	1	6	to	2	6
7.	Sandstone				1	6
8.	Clay shale	20	2	to	22	
9.	Sandstone or arenaceous shale	3	9	to	7	
10.	Arenaceous shale	2	6	to	3	
11.	Clay shale				3	6
12.	Coal		4	to		10
13.	Sandstone	1	3	to	3	
14.	Clay shale					4
15.	Slaty coal	1	6	to	1	9
16.	Sandstone or arenaceous shale	1	5	to	4	6
17.	Clay shale	1	4	to	2	
18.	Coal		6	to	1	0

	FEET.	IN.
19. Fire clay	2	3
20. Black slate	3	6
21. Bituminous shale		4
22. Fire clay	?	

In No. 9 of this section, there are some valuable quarries. The rock is from six to seven feet thick at some of the localities, and the whole of it is thick bedded, so that blocks of any desirable size can be had. There are, however, large concretions of a calcareo-arenaceous rock, locally called "flint," in the sandstones. One of these was taken from the quarry of Mr. J. Worden, section 14, that was about two and one-half feet thick, six to seven wide, and from ten to twelve long. This rock is very compact, hard enough to scratch glass, and in chloro-hydric acid effervesces slightly. It is not considered of any value, and is so hard that when it occurs in large masses it is very expensive getting it out of the way. At other localities, this sandstone is replaced by arenaceous shale.

No. 13 of the section is locally called "water flint," and is easily recognized, whenever met with in this vicinity, by the numerous specimens of *Stigmaria ficoides* present in it. These have much the appearance of dark brown or black roots, and in some cases the rock seems full of them. This rock is a somewhat argillaceous sandstone, compact, and not usually as hard as No. 9.

No. 15 may possibly be the representative of coal No. 1, but this seems doubtful.

In the northeast quarter of section 23, the strata appear to have been considerably disturbed, and at one place are tilted, for a short distance, to an angle of about 5°. Not far from here, two faults are to be seen within a few yards of each other.*

For some distance up the creek, northwest, the strata appear to have been somewhat disturbed, and dip in all directions. In sections 26 and 22, mines have been opened and more or less work done. In section 16, the following sections were obtained at points but a few rods apart:

	No. 1.		No. 2.	
	FEET.	IN.	FEET.	IN.
1. Coal	?		1	6
2. Fire clay		8		
3. Coal		3		
4. Arenaceous shale	2			
5. Light colored clay shale	1	8		8
6. Dark blue clay shale		4		11

---

*This appearance has probably been occasioned by the undermining of the strata in the erosion of the creek valley, and their subsequent displacement by being crushed downwards from the weight of the superincumbent beds. A. H. W.

	No. 1.		No. 2.	
	FEET.	IN.	FEET.	IN.
7. Sandstone		6	1	3
8. Black slate	8			?
9. Coal and black slate		3		

Several of the strata were readily traced from one point to the other, and this section will serve to illustrate how, in shafts only a short distance apart, the strata may vary considerably.

West of this point, in township 8, range 2, this seam crops out for some distance along Swan and Little Nigger creeks. At these localities mining has been carried on for years, and in places the bluffs are almost honey-combed by the entries, new and old. The mines along Little Nigger creek are mostly in sections 7, 8, 9 and 10. In some of them the fire-clay below the coal is varied in color, the usual tints being a light blue, though in some places it is nearly white, while in others it is yellow or yellow and red. It is said that on being burned the yellow turns to a blood red. Along Swan creek, the mines are in sections 15, 16 and 21. A little north of Roseville, in section 30, township 9, range 2, this seam has been worked to some extent.

The coals of this county are mostly worked by drifts, or tunnels driven horizontally into the hill-sides along the outcrop of the seams, and owing to the shaly character of the roof of No. 2, considerable expense is incurred in "cribbing" to sustain the roof. The thickness of the coal is usually from twenty inches to two feet, and in driving the entries it becomes necessary to remove a portion of the roof shales, or the under-clay, in order to obtain the amount of vertical space required to take out the coal.

The lower seam, No. 1 of the Illinois section, varies from two to four feet in thickness in this county. It is generally overlaid by black slate, or a dark colored, and frequently, shaly limestone. This forms a very good roof, and makes the working of this seam less expensive than that of the seam above, as, frequently, but little or no cribbing is required. In section 14, township 12, range 2, this coal crops out along the bluffs. In the eastern part of the section, it is from three to three and a-half feet thick, and as it is here overlaid by clay, the upper part of the coal is left for a roof. That part that is left is, however, of but little value, it being impure.

Flattened nodules of impure pyrite, called "nigger-heads" by the miners, and frequently a foot or so in diameter, are not uncommon at some localities in the upper part of this seam. Many of these contain numbers of fossils, which are frequently well preserved. Some of the nodules from this mine afforded *Productus longispinus*, var. *muricatus*, *Athyris subtilita*, *Spirifer cameratus*, *Chonetes mesoloba*, *Spiriferina Kentuckensis*, *Hemipronites crenistria*, *Pinna* ——*? Lima retifera*, *Schizodus curtus*, *Cardimorpha Missouriensis*, *Edmondia ovata*, *Streblopteria tenuilineata*, *Pleurophorus radiata*, *Allorisma subcuneata*, *A. costata*, *Bellerophon Montfortianus*, *Rhynchonella Eatoniæformis*, *Pleurotomaria Grayvillensis*, *P. sphærulata*, var. *depressa*, *Nautilus*, and some others not recognized.

Of these, the following species also occur in the upper Coal Measures: *Spirifer cameratus*, *Spiriferina Kentuckensis*, *Allorisma subcuneata*, *Athyris subtilita*, *Edmondia ovata*, *Lima retifera*, *Schizodus curtus*, *Pleurotomaria Grayvillensis*, *Bellerophon Montfortianus.*

A little west of this point and in the same section, the roof is black slate, a few inches thick, and is overlaid with limestone. Here the coal is but about three feet thick. In the western part of this section, the seam is from three and a-half to four feet thick, with a roof similar to the last. Did not learn the thickness of the limestone, but, judging from the exposures in some old quarries, it must be several feet. At these mines, sandstone underlies the coal. Besides these, there are other mines in this township, in sections 15, 22 and 23.

In township 12, range 1, there are a number of mines which probably belong to this seam. The exposures in sections 21, 22 and 27, showed 1 foot 6 inches of coal overlaid by 2 feet of soft clay shale.

There are also mines in sections 29, 30 and 32. As these are worked only during cold weather, I was able to make but little examination of them, as I visited this neighborhood in the summer. In township 12, range 2, the only mines in this seam are in sections 10 and 15. I am indebted to Mr. Chicken for the following section of the strata penetrated by his shaft:

		FEET.	IN.
1.	Soil and clay, about	4	
2.	Sandstone	5	
3.	Light colored clay shale	4	
4.	Dark blue clay shale	4	
5.	Compact calcareous clay shale	1	6
6.	Chert	1	6
7.	Clay		2
8.	Dark colored limestone	6 inch. to 2	
9.	Coal, average	2	8

In section 4, township 9, range 3, the coal is reported to be two feet two inches thick. As it lies below the bed of the stream, it is worked by means of a shaft. A shaly limestone lies but little above the coal, but I was unable to learn whether there is any slate between them. This mine is just south of the road on the township line, and on the other side of the road this limestone has been quarried. Here I obtained *Productus longispinus*, *P. semireticulatus*, *Aviculopecten*, *Naticopsis*, and some other fossils.

In township 9, range 1, on the southwest quarter of section 24, this seam crops out in the bluffs of Slug run, on the Peabody farm. The coal is about three feet thick, and overlaid by a dark, bluish limestone. About ten feet below this seam, there is an outcrop of the Burlington limestone, but the intervening strata were not exposed. In section 26, along Cedar Fork, this coal is exposed a little above the bed of the creek. A section of the strata gave:

	FEET.
1. Bluish-black limestone	8 to 10
2. Black slate	6 in. to 2
3. Coal	3

A short distance up the stream, there appears to be a fault, and apparently higher strata are exposed, and show the following succession:

	FEET.	IN.
1. Clay shale, not measured		
2. Sandstone, about	14	
3. Coal	1	1
4. Fire-clay, passing into clay shale	2	
5. Black slate, not measured		

The strata on either side can be traced to within a few feet of the fault. This, however, is not exposed, but a small gulch runs down the bluff at the point where it probably exists.

In section 13, township 8, range 1, there is another outcrop along Nigger creek, which probably belongs to this seam. The exposed strata give the following section:

	FEET.	IN.
1. Clay shale, not measured		
2. Coal		10
3. Shale, with a band of sandstone about 14 feet from the top	22	
4. Sandstone	1	6
5. Black slate	1	6
6. Coal, with some slate and clay shale	2 ft. 6 in. to 3	
7. Sandstone and arenaceous shale	3	4
8. Coal	from 1 in. to	2
9. Fire-clay	1	
10. Sandstone, not measured		

The mines at this place have been abandoned for some time. The coal was reported to be of poor quality, and mixed with slate.

It is probable that everywhere in this county, this seam lies but a few feet from the bottom of the Coal Measures, and wherever the lower strata are exposed, they rest upon the Burlington limestone. Northwest of Monmouth, in section 7, township 11, range 2, the rocks exposed in the bluff of Cedar creek gave the following section:

	FEET.
1. Slope, containing black slate, fire-clay and coal, not measured	
2. Sandstone, with thin beds of shale	10
3. Burlington limestone, as far as exposed	33

The coal mentioned in No. 1 of this section, is not likely to prove valuable, as it lies too near the surface.

At or near Monmouth, a boring was made, but I was unable to obtain a copy of the journal of the work, though it was promised me. As nearly as I could learn, only about ten inches of rotten coal was found. It is probable that it will be necessary to go farther east or south to find any place where the seam will prove workable.*

It is doubtful whether the lower seam can be found underlying No. 2 throughout the county, but still it may, and probably does exist all along the eastern border. At the outcrop in Henderson county, a few miles southwest of Ellison, coal No 2 lies but a short distance above the lower formations, and the same may prove to be the case along the southwestern portion of this county. Still, a seam, which is probably No. 1, is found but a short distance northeast of Ellison. In searching for coal, either by sinking a shaft or otherwise, it should always be borne in mind that, when any of the beds of Lower Carboniferous limestone are reached, it is useless to go deeper in search of it.

Burlington Limestone.—The beds of this group immediately underlie the Coal Measures in this county, wherever the junction of the coal with the underlying beds can be seen. In the south part of the county, there may be thin beds of the St. Louis between them, and east of Biggsville, and near Young America, the Keokuk may be present, but there are no outcrops where either can be seen beneath the Coal Measures.

The Burlington group, in Warren county, consists mainly of light gray and brown limestones, with some layers of sandstone, chert and calcareous clay shale, and attains a thickness of from forty to fifty feet. These beds outcrop along the small streams in the southern part of township 12, range 3. Section 31 furnishes layers of good building material, sufficiently thick for all ordinary purposes. In sections 32 and 33, it is thin bedded where it has been worked. In section 35, at Rockwell's mill, on Cedar creek, the rock is quite arenaceous. When the quarries were first opened they afforded good limestone, but on working into the bluff, the beds are changed to a soft or rotten sandstone. This exposure of the strata gave the following section :

		FEET.	IN.
1.	Limestone and sandstone	15	6
2.	Sandstone	17	
3.	Green, argillaceous sand		1
4.	Shales of Kinderhook to the bed of the creek	17	

East of this, in sections 19, 20, 29 and 30, township 12, range 2, the Burlington limestone outcrops along some of the small streams, and is overlaid by thin strata of the Coal Measures. As far as exposed here, it is somewhat arenaceous, with much chert. This is the most northerly outcrop of the group in this county, and in Henderson county it is exposed but a very little further north. Thin outliers may be found for some distance in this direction, beneath the Coal Measures, but, like the other members of the Sub-carboniferous series, it soon thins out.

---

*Since this report was made, Dr. A. W. Black, of Monmouth, has sunk a shaft to the coal, which was found at the depth of about forty feet below the surface. The shaft is a little east of the city, and the coal found to be from twenty-four to thirty inches in thickness and of excellent quality. This is probably coal No. 2 of the Fulton county section. A. H. W.

In section 1, township 11, range 3, there are extensive quarries in this limestone. Some of the layers are very light colored and even textured, and are reported to take a good polish. Other layers, though not as light colored, furnish a durable building material. Much lime is burned here, and the rock being nearly a pure carbonate of lime, affords a good article. In section 2 and the northwest quarter of 11, there are small outcrops. In sections 4, 5, and the north part of 8, there are exposures all along some small streams. The one in section 4 gave the following succession of strata:

		FEET.	IN.
1.	Chert	2	
2.	Thin bedded sandstone, with a little chert	7	
3.	Limestone and chert	1	9
4.	Limestone	9	6
5.	Slope to the water, with outcrop of limestone	5	6

Much material, both for building and making lime, has been taken from these places. As we go south, from the north line of the township, we find thin outliers of the Coal Measures forming the tops of the bluffs, till in section 8 the Burlington beds disappear beneath the sandstone and conglomerate which form the base of the Coal Measures.

On Cedar creek, from Rockwell's mill in township 12, range 3, to Olmstead's mill in township 11, range 2, this limestone outcrops almost continuously along the bluffs, frequently in perpendicular or overhanging ledges. Occasionally it is covered by the sloping talus of the hills, but only to be again exposed a little further on. In section 7 of the latter township, it is overlaid by a few feet of the Coal Measures, and at this point gave the following section:

		FEET.	IN.
1.	Slope, with outcrops of Coal Measure strata. Not measured.		
2.	Slope, with outcrops of Burlington limestone	7	6
3.	Limestone and chert	3	2
4.	Compact calcareous clay shale	2	
5.	Limestone	11	6
6.	Sandstone and limestone, to the bed of the creek	8	6

Near the middle of section 7, on Cedar creek, and along a little branch putting in from the southeast, there are extensive quarries in the bluffs, which supply Monmouth and the adjoining region with large quantities of excellent building material. As we proceed up the creek, the outcrops, though still large, are not as extensive as below, being more frequently covered by the talus of the bluffs. In the east part of section 7, they are overlaid by heavy beds of Coal Measure sandstone. Small quarries have been opened at various points from here to the east half of section 8, where, a few rods south of the Cedar, and along some small runs that put into it, there are extensive quarries. The rock obtained here is mostly taken to Monmouth and its vicinity. At this place, and for some distance up the creek, the bluffs are not as high as farther down, and the Coal Measure strata have been largely, and in some places entirely removed. From here to the middle of section 9, though occasionally outcropping, the rock has been but little worked. At this point there is a small quarry on a run coming in from the northeast. Near this, along a branch entering the Cedar from the south, the rock has been almost continuously worked, from near the mouth of the stream to the center of section 16. In the southeast quarter of section 9, the Burlington limestone disappears beneath the strata of the Coal Measures, and does not again appear to the eastward, along Cedar creek.

In section 24, township 9, range 1, the strata dip to the north of west and the south of east, forming an anticlinal. As only a few feet of the beds were exposed, I was unable to determine, accurately, the direction of the dip and the trend of the anticlinal. To the eastward, the Coal Measures thicken, and it is not probable that the limestone is again exposed.

The limestones of this group are generally rich in fossil remains, which are well preserved, and the rock is largely composed, in most cases, of the fragments of crinoidea, and at almost every point where it is exposed, more or less good fossils may be obtained. Among the Brachiopoda found here, were *Spirifer Grimesi*, *S. plenus*, *Productus semireticulatus*, var. *Burlingtonensis*, *Orthis Michelini*, and *O. Swallovi.*

The crinoidea are not as common as farther west, but some fine ones were obtained there, among which were *Actinocrinus rotundus*, *A. oblatus*, *Batocrinus Verneuilianus*, *B. Christyi*, *B. Konincki*, *B. pyriformis*, *Agaricocrinus*, *Granatocrinus Norwoodi*, and *Pentremites elongatus.*

Kinderhook Group.—The beds of this group, which underlie the Burlington limestone, are, as far as exposed in this county, composed of shale, with occasional layers that are more or less calcareous or arenaceous, and compact. Some of the more compact portions might be used for building purposes, where not exposed to the weather; but an abundance of far superior building stone renders this unnecessary. It seems probable that but a few feet of the upper portions of the group are exposed at the different outcrops, but being, apparently, destitute of fossils, it is difficult to recognise the beds. At Rockwell's mill, section 35, township 12, range 3, there is an exposure which gives this section :

		FEET.	IN.
1.	Burlington limestone	32	6
2.	Compact, calcareous clay shale, from 6 inches to	1	
3.	Blue clay shale, to the level of the creek	16	

In the south part of section 15, there is another outcrop of a few feet along a small branch, and in section 9 there is an exposure of shale which probably belongs to the Kinderhook. At this point, one or two shafts have been sunk, for a short distance, in search of coal. It is reported that the water came in so fast that the work was suspended, without, of course, having found any indications of coal.

North of here, the beds of this group are not exposed, but may extend for some distance in that direction beneath the Coal Measures, but, like the other members of the lower Carboniferous series, this group also soon thins out. There were no fossils found in these beds at any point in the county.

As these shales very closely resemble those of the Coal Measures, those unacquainted with geology will be very likely to mistake them for the latter. This has been done at nearly every exposure, though, as far as I learned, but little time had been spent in examinations. Notwithstanding all that experienced coal-miners may say to the contrary, it is useless to search for coal in the shales of the Kinderhook group.

Economical Geology.

Coal.—The supply of this valuable mineral is mostly obtained from seams Nos. 1 and 2, the upper bed, No. 3, affording but a small amount. Coal No. 2, though thinner at most places than No. 1, is more extensively worked, as it is generally more easily got at, and affords an excellent quality of coal. This seam has been worked principally in townships 8, 9 and 11, ranges 1 and 2. At most of the mines, there is more or less sulphuret of iron mixed with the coal, which has to be separated from it before sending it to market.

The lower seam is, at nearly all localities, considerably thicker than No. 2, and hence the yield is much greater. This coal, though generally of fair quality, is not as good as that from the bed above. It has been worked principally in township 9, range 1, township 11, range 2, and township 12, ranges 1 and 2. It probably underlies the whole of the township 9, of range 1, and a considerable portion of each in range 2, and, perhaps, a portion of townships 8, 9 and 10, of range 3. At a single place in range 3, along the dividing line between townships 9 and 10, coal, apparently belonging to this seam, has been found, and a mine opened. The coal is but twenty-six inches thick at this point.

Building Stone.—The Burlington limestone furnishes a good article of building stone, and is found along the southern part of township 12, range 3, and the northern part of township 11, range 3, also in the northwest part of township 11, range 2. From Rockwell's mill for several miles up Cedar creek, the outcrops of these beds form mural, or overhanging bluffs, from thirty to forty feet high. Notwithstanding the immense quantities of stone taken from this region, these vast ledges appear to have been but slightly worked at a few points. These outcrops are not on Cedar alone, but along all the branches that enter it in this vicinity. Nearly all the rock is light colored, some portions being tinged with a light shade of buff, and others with blue. It is compact and dresses well, and some of the layers afford a stone susceptible of taking a good polish.

The sandstones of the Coal Measures furnish a large amount of valuable building rock, and the most extensive quarries are in Greenbush and Berwick townships. The most important quarries in Greenbush, township 8, range 1, are located along Nigger creek in sections 14 and 15. The following section will show the thickness and relative position of the beds:

		FEET.	IN.
1.	Coal, No. 2 of the Illinois section	1	6
2.	Fire clay	3	
3.	Clay shale	11	
4.	Coal and black slate		8
5.	Clay shale from 1 foot 6 in. to	2	6
6.	Sandstone	1	6
7.	Clay shale from 20 ft. 2 in. to	22	
8.	Sandstone or shale " 3 ft. 9 in. to	7	

The quarries are in No. 8 of this section, and the rock is from five to seven feet thick where worked.

The most important quarries in Berwick, township 9, range 1, are in sections 14 and 15, along Slug run, and in sections 18 and 20, on Cedar Fork. The sandstone is much thicker here than in Greenbush, it being from twelve to fourteen feet thick, and in some places more. I was unable to ascertain the position of the strata in which those quarries are, but it may be the same as No. 8 of the last section.

In section 11, the sandstone forms immense ledges, which in some places overhang the water ten and fifteen feet. "Rock House," as it is called, is in this section, and was formed in some past time, when the bed of the stream was considerably higher than at present, by the water cutting a passage through a portion of the lower strata. In the denuding process, a large pillar of sandstone was left, and now supports the outer edge of the upper strata, which forms the roof.

In some localities along Slug run, this sandstone is of little value, as it crumbles to pieces by exposure to the weather. The quarry stone is quite soft, splits readily and dresses easily, and may be obtained in large blocks. In some of the quarries, there is a bluish calcareo-arenaceous rock, hard and tough, that occurs in concretions. This makes a very durable building stone, but is hard to work.

In section 8, township 11, range 3, there is a somewhat extensive quarry in the sandstone below coal No. 1, and very near the bottom of the Coal Measures. A similar rock was formerly worked in sections 7 and 8, township 11, range 2, along Cedar creek. Besides those already mentioned, there are some smaller quarries in township 9, range 3, township 10, range 1, and township 12, ranges 1 and 2.

Limestone for Lime.—Nearly all the outcrops of the Burlington will afford abundant supplies of material for this purpose, and being nearly pure carbonate of lime, yields an excellent article. Some of the Coal Measure limestone has been burned, but the supply from this source is very limited. Lime is, at present, most extensively manufactured in section 1, township 11, range 3. Better facilities for getting fuel for the kilns, and the manufactured lime to market, is all that is necessary to render this business an important source of wealth to some portions of the county.

CHAPTER XX.

MERCER COUNTY.

Mercer county lies on the northwestern border of the State, and embraces a little more than fifteen townships, or about five hundred and fifty square miles. It is bounded, on the north, by Rock Island county; on the east, by Henry and Knox; on the south, by Warren and Henderson; and on the west, by the Mississippi river. The fourth principal meridian passes along its eastern border, and it embraces townships 13, 14, and 15 north, of ranges 1, 2, 3, 4 and a part of 5 and 6 west.

It is intersected from east to west, through the northern portion, by Edwards river, which, near the western border, changes its course, and, running in a southwesterly direction, empties into the Mississippi about a mile and a-half below New Boston. A few miles south of the Edwards is Pope creek, which passes through the county in the same direction, and enters the Mississippi at Keithsburg. In addition to these, there are in the northwest, Eliza creek, which empties into Swan lake, and Camp creek, a tributary of the Edwards; while in the northeast are Parker's run and another Camp creek, also branches of the Edwards. South of these is North Pope, a tributary of Pope creek, and in the southeast are North Henderson and Duck creeks. These, together with some smaller streams, furnish an abundant supply of water.

A large portion of this county is prairie, while along the borders of the streams are the so-called "barrens." The soil of the prairie is usually a deep black or chocolate colored loam, with a yellow or dark brown clay subsoil. The soil of the barrens is similar to that of the prairie, only lighter colored and of less depth, while along the upper part of the slope it is of a light brown or yellowish color, owing to the character of the subsoil, which comes near the surface. In some portions of the barrens, there is but a thin covering of soil, and in these places it is quite light colored, showing that but little humus is present.

Surface Geology.

The surface deposits of this county comprise the usual subdivisions of the Quaternary, Alluvium, Loess and Drift. The most extensive alluvial deposit is that of the Mississippi bottom. This extends along the whole western border of the county, with a varied width of from two to five miles. Of this, that portion which is situated in the northwest, and extends as far south as New Boston, is much cut up by swamps, lakes and bays. Much of this land is comparatively low, and valuable chiefly for meadow and grazing.

Through a large portion of these bottom lands, there are one or more low ridges of sand. The soil of this sandy portion is of but little value, there being but few seasons when it is wet enough to produce full crops. In other portions, the soil is a deep black loam and very productive. Narrow alluvial belts are also found along nearly all the water courses, the soil of which is very dark colored, but more or less intermingled with sand and pebbles.

Loess.—This deposit is found capping the Mississippi bluffs, and attains a variable thickness of from ten to forty feet. It is a calcareous marl of light brown or buff color, and generally contains great numbers of bleached fresh water shells, mostly of species existing in the streams of the adjoining region.

Drift.—The deposits of this subdivision comprise a series of brown and blue clays, locally intermingled with sand, gravel and small pebbles, which are spread over the entire surface of the uplands, and underlying the Loess, where both are present. Some large boulders of igneous or metamorphic rocks lie scattered in the valleys of the water courses, but they are not numerous. In section 9, township 13, range 4, and forming a portion of the bluff of Pope creek, there are heavy beds of a sandy marl, containing some recent shells. Two genera were recognized among the specimens obtained here, *Limnea* and *Succinea*. Some fifteen or twenty feet of these beds were exposed, and they appear to underlie the yellow clays of the Drift, which form the subsoil.*

The older geological formations exposed in this county, belong to the Coal Measures and the Kinderkook group.

Coal Measures.—Nearly all the stratified rocks exposed in this county belong to the Coal Measures, and include the lower portion from coal No. 3 (?) of the Illinois section, to near the base of this formation. They comprise various strata of limestone, sandstone, clay shale and coal, and attain a thickness of from one hundred to one hundred and fifty, or possibly, in some places, two hundred feet. There are three, perhaps four, seams of coal worked in this county.

---

* It is probable the beds of sandy marl here referred to, are equivalent to the Post Tertiary beds of stratified sands, clays, etc., mentioned in the preceding chapters as occurring in McLean, Tazewell, Adams, and some other counties, and though underlying, and consequently older than the Drift, they have as yet afforded no fossil molluscs of extinct species.

A. H. W.

The upper seam, No. 3 (?) of the Illinois section, has been found and worked at but one point, sections 31 and 32, township 14, range 2. This seam is from three to five feet thick, and the coal of good quality. From Mr. Martin's shaft in the southwest quarter of section 32, and the exposed rocks in the bluff below, the following section was obtained :

			FEET.	IN.
1.	Drift. Not measured.			
2.	White clay, sometimes sandy		7	
3.	Limestone, impure		18	
4.	Coal No. 3 (?)	3 to	5	
5.	Sandstone, or sandy shale	10 "	15	
6.	Slate, not always present		2	
7.	Limestone			8
8.	Coal	1 foot 10 in. to	2	6
9.	Clay		4	
10.	Slate, penetrated		16	

The limestone over the coal No. 4 of this section, contains numerous fossils, among which are *Hemipronites crenistria*, *Lima retifera*, *Productus Nebrascensis*, *Conularia*, and several species of *Bryozoa*.

The second coal seam, No. 2 of the Illinois section, is, in this county, from one and a-half to two and a-half feet thick. This seam has been found in quite a number of places, but is, at present, worked at but two or three points. In sections 20 and 21, township 13, range 2, it has been extensively mined, though but one mine, in section 20, is now in operation. The exposed strata in this vicinity give the following section:

			FEET.	IN.
1.	Coal, No. 3 (?), a trace.			
2.	Sandstone, or sandy clay, about		15	
3.	Limestone, impure and shaly	1 foot 2 in. to	1	4
4.	Blue arenaceous clay shale	6 in. "	1	
5.	Coal, No. 2	2 feet "	2	6
6.	Blue clay, but partially exposed.			

The sandstone, No. 2 of this section, is light colored and soft, but hardens on exposure. The quarries that are and may be opened at or near this locality, will furnish an abundant supply of a fair article of building stone for the supply of the adjacent region. About two miles down North Henderson creek, in the southwest quarter of section 19, there is an extensive quarry of sandstone and conglomerate. This probably lies below coal No. 2, and near the base of the Coal Measures. The sandstone is of fair quality, and can be had in blocks of any desirable size, and, when first taken out, is soft and easily worked, but hardens by exposure. The conglomerate, though of little value to the builder, is interesting to the geologist on account of its containing a considerable amount of the cherts of the Burlington limestone. These are almost entirely composed of crinoid stems and heads, and a few other fossils. As is commonly the case in these cherts, the fossils are not often well preserved, and of those obtained, but few could be recognized, among which were *Batocrinus oblatus*, *Actinocrinus*, *Platycrinus* —, and *Spirifer imbrex*.

In section 32, township 14, range 2, the coal seam No. 2 was formerly worked, but the thicker seam above having been discovered, this one was abandoned. In section 33, township 14, range 3, a mine was opened a few years since, but the amount of pyrite contained in the coal was so great, that it could not be profitably worked in competition with the better coals. Near Aledo, in section 20, several banks have been opened, at one of which the following section was obtained:

	FEET.	IN.
1. Clay shale. Not measured.		
2. Limestone	1 to 1	6
3. Clay, passing into clay shale		3 to 4
4. Coal No. 2	1 foot 6 in. to 2	
5. Clay. Not measured.		

No. 2 of this section, and the lower portion of the shale above it, contains a number of fossils, among which are *Spirifer lineatus*, *Athyris subtilita*, *Pleurophorus soleniformis*, *Productus*, etc. In section 8, a little north of Aledo, a mine was opened, though worked but little, in which the strata presented a peculiar feature, as will be seen from the following section:

	FEET.	IN.
1. Shale. Not measured.		
2. Sandstone	8 to 9	
3. Clay shale	1 " 3	
4. Coal		8
5. Limestone		6
6. Coal	1	6
7. Clay. Not measured.		

This is the only instance in which I have noticed a stratum of limestone separating the coal.

In section 9, there are extensive quarries in the sandstone, No. 2 of the last section. They have been worked for years, and have furnished immense amounts of good building material.

Near Millersburg, section 2, township 14, range 4, there is a mine that is worked where the coal is from two to two and a half feet thick.

Section 1 affords a sandstone which is much harder than that obtained from most of the other quarries. There is but a single layer found here, and this is only from a foot and a half to two feet thick. I was unable to learn its position, as but little of the strata above or below was exposed. The material for the foundation of the jail at Aledo was taken from this locality.

A little coal has been mined in sections 35 and 36, township 15, range 3. The exposed strata here gave—

		FT.	IN	FT.	IN
1.	Clay shale. Not measured				
2.	Sandstone, about			15	
3.	Blue clay or clay shale	2		to 3	
4.	Coal	1	6	to 2	
5.	Clay. Not measured				

There are extensive quarries in the sandstone, No. 2 of this section, in this vicinity. Though soft when taken out, it hardens by exposure, and is light colored and thick bedded. Much of the material for the walls of the Aledo jail was taken from the quarries in section 35.

The lower coal seam, No. 1 of the Illinois section, varies in thickness from three to four feet, and it is from this seam that the principal part of the coal for the supply of this region is obtained. From the mine in the southeast quarter of section 1, township 14, range 3, the following section was obtained:

		FEET.	IN.
1.	Impure, gray limestone	8	
2.	Flinty limestone	6	
3.	Blue limestone	3	
4.	Black slate	1 ft. 6 in. 2	
5.	Coal	1	6
6.	Slate or shale		4
7.	Slaty coal		4
8.	Coal	1	8
9.	Sandy clay. Not measured		

A little farther west, the dividing slate in the upper coal was reported to be four feet thick, and at a mine east of this, in section 6, township 14, range 2, it is one foot and eight inches. Where it becomes so thick, the mining is rendered very expensive, and these mines have been abandoned for the present. In sections 3, 4, 5 and 6, township 14, range 2, this seam has been extensively worked. A general idea of the position of the strata may be obtained from a section made at the mines and quarries in section 4:

		FEET.
1.	Impure, drab colored limestone	15
2.	Blue limestone	2
3.	Coal	4
4.	Sandy clay. Not measured	

The shaly seam, mentioned above as dividing the coal into two parts, is only found at a few mines, and is generally quite thin. The limestone, No. 1 of the section, is extensively quarried in sections 3, 4 and 5. The rock is mostly in thin layers, from two to eight inches in thickness. The large slabs that form the roof and floor of the cells of the Aledo jail, were taken from section 4, and some of the thicker layers were used for the walls of the cells.

The blue limestone, No. 2 of the section, is of little or no value for building stone, as it falls to pieces on being exposed to the weather a short time. It is sometimes burned for lime.

Large quantities of the gray or drab colored limestone are taken from the quarries of H. Boone, Esq., in section 34, township 15, range 2. The coal, No. 3 of the last section, is also worked here.

From the mines in section 19, township 15, range 3, and sections 23 and 24, township 15, range 4, the following section was obtained:

		FEET.
1.	Sandstone. Not measured	
2.	Limestone	2 to 4
3.	Black slate	1 to 3
4.	Coal	3
5.	Clay shale. Not measured	

The black slate, No. 3 of this section, in some cases attains a local thickness that was not noticed elsewhere in this county. A number of mines have been worked in section 34, township 15, range 4. In section 12, township 14, range 4, there is a coal shaft near the Edwards river. The following section, obtained in part from the slope above, and in part from the shaft, was furnished me by the proprietor of the shaft, B. C. Taliaferro, Esq., of Keithsburg:

		FT.	FT.	IN.
1.	Coal No. 2	1 to	1	6
2.	Slope	12 to	15	
3.	Clay, very hard and compact		4	
4.	Quicksand or decomposed sandstone		3	
5.	Clay shale, very hard		23	
6.	Coal No. 1		3	6
7.	Impure coal, or slate			6
8.	White clay. Not measured			

The coal obtained from this mine is reported to be of good quality. A layer of sandstone in section 8 has furnished considerable building stone, but no work appears to have been done here for some time.

From the mines in sections 20 and 21, township 15, range 1, the following section was obtained:

		FT.	IN.	FT.
1.	Sandstone	4		to 6
2.	Limestone	1		to 21
3.	Coal No. 1	3		to 4
4.	Sandy clay shale			8
5.	Limestone	6		to 8
6.	Coal	1	6	to 6

No. 3 of this section is supposed to represent No. 1 coal. It very closely resembles, in appearance and position, the coal which in other localities in the county is referred to this seam.

No. 6 is reported to have been worked in sections 16 and 20. None of the mines were in operation at the time I was there, and I was unable to make a very satisfactory examination of them. In section 16, at Captain Sisson's mill, this seam was worked by means of a shaft. The coal was reported to be six feet thick, but thinned out towards the east. This may be only a development of No. 1 coal in two divisions, a phenomenon by no means uncommon in other and adjacent counties. As will be seen from the section, these seams are about fifteen feet apart, and nearly half the intervening strata are limestone. A broken coal was reported to have been found in section 1, township 14, range 3, in digging the drain, which at that point is quite deep, and this may correspond with the lower coal of the last section.

In section 34, of this same township, along Parker's run, a coal seam is worked, which may belong to coal No. 1, or perhaps to No. 2. There was but one mine open here, and in this, "horsebacks" or slips are numerous, and the thickness of the coal quite variable. The following section was made here:

		FT.	FT.	IN.
1.	Sandstone. Not measured			
2.	Limestone	2	to 3	
3.	Black slate	2	to 2	6
4.	Coal	2	to 2	8
5.	Sandy clay		5	
6.	Sandstone. Not fully exposed			

This seam more nearly resembles coal No. 2, as it is usually found in this county, in quality and thickness, than No. 1; but No. 2 is seldom overlaid by black slate or underlaid by sandy clay, and both are common with No. 1.

Kinderhook Group.—The only strata belonging to this group that I found exposed in this county, are in section 5, township 13, range 5, near the mouth of Edwards river. Quarries have been opened at this point, and in years past much building material has been taken from here. Both limestone and sandstone, the latter containing considerable magnesia, are found here. These quarries lie but little above the level of the Mississippi, and are overflowed at high water. But little work appears to have been done at these quarries for some time. Fragments of fossils were observed, but nothing perfect enough for identification was obtained.

Economical Geology.

Building Stone.—Mercer county has, in some parts, an abundant supply of this material, both of sandstone and limestone. With but one exception, the quarries are in strata belonging to the Coal Measures. Nearly all the most important sandstone quarries appear to belong to one horizon, which is but a few feet above coal No. 2. This bed is worked in section 21, township 13, range 2, section 9, township 14, range 3, sections 35 and 36, township 15, range 3, and in some other places. When first taken out, the stone is quite soft, and is easily cut into blocks of any desired size, but on exposure becomes harder. So easily is this stone worked, that an old ax is frequently used, and is all that is necessary to dress the more irregular and uneven beds into shape, and is also frequently used to split the larger ones. These quarries have been opened along the slopes of the hills where but little material has to be removed to reach the rock, and when heavy stripping is required, the quarries are abandoned and new ones opened. Though this sandstone bed is not continuous, frequently changing into sand or sandy shale, still the workable portions are sufficiently extensive to render the supply inexhaustible.

Another extensive sandstone quarry is in section 19, township 13, range 2 This is probably below coal No. 2, and appears to be near the base of the Coal Measures.

In sections 3, 4 and 5, township 14, range 2, there are extensive quarries of gray or drab colored limestone. The rock is mostly quite thin bedded, very few of the layers reaching eight inches in thickness. It is, however, largely used and much liked. This bed is from ten to fifteen feet in thickness, and is separated from coal No. 1, which lies below it, by two feet of blue limestone. The quarries of H. Boone, Esq., in section 34, township 15, range 2, are in this bed. Large amounts of building material have been taken from these quarries, and still the rock has only been worked back for a few feet along some of its outcrops.

A hard, calcareo-arenaceous rock has been quarried to some extent in the northwest quarter of section 15, township 15, range 3. Building stone has also been obtained from the Coal Measure rocks at a number of other places.

The Kinderhook group affords a fair article of building stone, which has been quarried on section 5, township 13, range 5, just north of the mouth of the Edwards river, and on the point of land formed by it and the Mississippi. Both sandstone and limestone are found here, and considerable material has been taken out in times past, though at present the quarries appear to be nearly abandoned.

Limestone for Lime.—Some of the blue limestone, No. 2 of the last section, found above coal No. 1, has been burned, and produces a fair article of lime, but generally needs to be screened before using, and the amount thus obtained is comparatively small.

Coal.—Mercer county has an abundant, though unequally distributed, supply of coal. The upper seam, No. 3 (?), has been found only in sections 31 and 32, township 14, range 2. The coal is from three to five feet thick, and at the time I was there, there were two shafts and a drift bank in operation. These mines furnish a large amount of good coal. To the east, this seam was reported to thin out within a short distance. On going still farther east, it may become thicker, and should this be the case, the seam may be found and worked in the eastern part of the county. No coal has been discovered from this point for about twelve or fourteen miles up the creek, where a seam, probably coal No. 4, is worked in section 3 of the northwestern township of Knox county. It is thought that there is a coal seam in section 5 of this township, lying below the bed of Pope creek, which may be No. 3 (?), and in that case it could, probably, be found between this point and the mines in township 14, range 2, in Mercer county.

The next coal seam, No. 2, has been found over a much larger area. This seam, however, is only from one and a-half to two and a-half feet thick. At present, the only mines in operation are in section 20, township 13, range 2, section 20, township 14, range 3, and section 1, township 14, range 4. This seam has been opened in a numbar of other places, but from one cause or another, the mines have been abandoned for the present. The amount of coal now obtained from this seam is comparatively small, but in most places the quality is good. It probably underlies a portion of townships 13 and 14, range 1, the larger part of township 13, range 2, and the northern part of township 14, range 2, a little of the northern part of township 13, range 3, nearly all of township 14, range 3, the northeastern part of township 14, range 4, a part of township 15, ranges 2 and 3, the northwest part of township 15, range 4, and the uplands of township 15, range 5. Although it has not been found in township 15, ranges 4 or 5, I think that it may be, from the fact, that in or near section 21, township 16, range 5, Rock Island county, a two-foot seam of coal, resembling No. 2, is worked. This coal is found but little above the bed of Copperas creek, and the mines are only about three miles from the north line of township 15, range 5. The coal is worked both by drifts and a shaft, and is said to be of excellent quality. Traces of coal were reported to have been discovered in or near section 8, township 15, range 5, and if so, it may belong to this seam.

The lower seam, No. 1, affords the larger part of the coal now used in this county. It is from three to four feet thick and underlies a large area, but is most extensively worked in township 14, ranges 2 and 3, and township 15, ranges 1, 2 and 4. It probably underlies township 13, ranges 1 and 2, townships 14 and 15, ranges 1, 2, 3 and 4, and perhaps a portion of township 13, ranges 3 and 4, and township 15, range 5. Coal No. 1 is not always found where No. 2 is developed and its proper horizon is exposed, as in some places, particularly along the outer edges of the coal field, the lower part of the measures were not deposited very regularly, and hence, in some of the above-named places coal No. 1 may not be found; In section 19, township 13, range 2, the rock at the quarries has the appearance of belonging to the conglomerate, at the base of the Measures, which lies below coal No. 1, although No. 2 is found at the bottom of the bluff within about two miles up the creek, and the strata appeared to be nearly horizontal. At some of the mines, the coal from this lower seam is not of the best quality, there being much slaty material with it which requires to be sorted out before it is sent to market. This is not always carefully done, and thereby the value of the coal, and the reputation of the mine is much injured.

In searching for these lower seams, it is well to know beforehand whether the Coal Measures are present and upon what they rest, though it seems probable that some of the strata belonging to the coal series will be found throughout the county, with, perhaps, the exception, of the bottom lands of the Mississippi.

None of the underlying strata have been seen in townships 14 and 15, but the coal seam worked along the Edwards, is most likely the lowest one, unless the lower one found in Richland Grove, township 15, range 1, should prove to be a different seam. This lower seam was recognized with certainty at but two places, about a mile apart, and was reported to be, in each case, about fifteen feet below the seam supposed to be No. 1, and it is not improbable that this may prove to be only a lower division of No. 1. In section 1, township 14, range 3, the strata dip as the entry runs back from the mouth of the mine, hence they were obliged to make the drain quite deep, and in digging this they found a broken coal about fifteen feet below the one they work, which is probably the lower division of the seam.

In township 13, ranges 1 and 2, the Coal Measures may rest, at least along the southern border, upon the Burlington limestone, though it is not certain that this group extends as far north as this, but it is not improbable. Should it be present it will form a horizon readily recognized, below which coal need not be looked for, as the light colored crinoidal, or even the brown arenaceous limestone is very different in appearance from the limestones of the Coal Measures, which are usually dark colored and fine grained.

From the southern part of Henderson county, where the Burlington limestone outcrops, to its most northerly exposure at Bald Bluff, the strata rise gradually. East of here, at the most northerly exposure of the junction of this group with the Kinderhook, in section 35, township 12, range 3, in Warren county, it is nearly twenty feet above the level of Cedar creek, and probably not less than forty to sixty feet above the Mississippi. At this point the whole of the Burlington rocks appear to be exposed, and do not exceed thirty-five or forty feet in thickness. East of here they are exposed a very little farther north, when they disappear beneath the Coal Meaaures. In range 3, the surface of which is considerably lower for some distance than that of ranges 1 and 2, it will not probably be found north of section 35, township 12. All the stratified rocks that have been observed north of this in this township, appear to belong to the underlying Kinderhook group. Hence it seems probable that along some portions of the southern border of Mercer county, the Coal Measures rest upon the Kinderhook group. As the latter is here composed of shales much resembling those of the Coal Measures, it will be very difficult, if not impossible, for the miner, who knows nothing about geology, to tell when he has reached the horizon, below which coal cannot be found, and he may dig or bore into the Lower Carboniferous beds without the slightest prospect of reward for his labor.

A much larger amount of coal might be taken out in this county, were the demand sufficient to warrant it, none of the mines being worked to their full capacity at the present time. The railroad now being constructed intersects the county from east to west, and runs within three miles of nearly all the mines along Edwards river, while some of them are much nearer, and those along Pope creek, sections 31 and 32, township 14, range 2, are less than four miles from it. It is probable that at almost any place between Windsor and Monroe, a shaft might be sunk, near the railroad, and reach a workable seam of coal at a depth not exceeding one hundred and fifty or two hundred feet. This road once in operation, new mines will be opened, and sections that are now unable to obtain coal at reasonable rates will be supplied, while those who have coal lands near the road will find their value much increased.

Pyrite.—This is a sulphuret of iron, and the so-called "sulphur" of the miners. It is more or less mixed with the coal of all the seams, and is the great bane of all our western coals. It occurs in various forms, sometimes in crystals, and thin vertical layers disseminated throughout the coal, and again in horizontal bands. In the latter case, it is readily separated from the coal in the mines, but in the former this cannot be done. If much of it be present the coal is valueless for blacksmithing purposes, as it renders the iron brittle. If the coal is to be used in the manufacture of iron, the sulphur of the pyrite may be removed by coking. This mineral is of no value, save for the manufacture of copperas (sulphate of iron) and sulphuric acid.

Timber, Soil and Agriculture.—The soil of the prairie is a dark colored or black loam, containing much humus, and everywhere productive, when properly drained and cultivated. Corn and other cereals are the principal crops. The soil of those portions which skirt the water courses is usually much lighter colored, and of less depth than that of the prairie. Though much less productive, it is better adapted to some crops, particularly fruits. Nearly all these lands were originally timbered, but large portions of them have been cleared, either to obtain fuel or for cultivation. The most abundant kinds of timber found here, and along the slopes of the hills are, white, bur, black, red and laurel oak, red and white elm, blue and white ash, bitternut and scaly-bark hickory, sugar and white maple, wild cherry, and red-bud, with occasionally black walnut, butternut and American aspen. In the creek bottoms there are, in addition to these, honey-locust, sycamore, cottonwood, ash-leaved maple or box elder, buckeye, wild plum, thorn and crab apple. Grape vines and other climbers are abundant.

The bottom lands of the Mississippi are in part prairie, and in part covered with a heavy growth of timber, consisting of sycamore, cottonwood, black walnut, butternut, red and white elm, white and sugar maple, buckeye, coffee tree, honey-locust, hackberry and the common varieties of oak, hickory and ash. This land is very fertile, and produces large crops of hay, corn, etc.

A large portion of townships 14 and 15, range 6, is comparatively low land, and valuable principally for timber, grazing and meadow. Some parts of this produce immense quantities of a coarse grass, which is much liked by cattle, and hence stock growing is extensively carried on in some portions of the county.

Other portions of these bottom lands are very sandy and the soil poor, but in wet seasons comparatively large crops may be raised here by proper cultivation and fertilizing. Irish and sweet potatoes do better here than on the prairies. Some portions of this sandy land is covered with a scrubby growth of timber, consisting of black-jack, black, white and red oak, and shell-bark, and bitternut hickory.

CHAPTER XXI.

KNOX COUNTY.

Knox county comprises a superficial area of twenty townships, or seven hundred and twenty square miles. It is bounded, on the north, by Henry county; on the east, by Stark and Peoria; on the south, by Fulton; and on the west, by Warren and Mercer. The fourth principal meridian passes along its western border, and it embraces townships 9, 10, 11, 12 and 13 north, of ranges 1, 2, 3 and 4 east.

The southeastern part of the county is intersected by Spoon river, which enters it in township 11, range 4, and passes out in township 9, range 2. French and Littler's creeks lie to the east, while Haw and Court creeks with their branches, the larger of which are Brush, Middle, North and Sugar creeks, lie on the west. In the northeast, is Walnut creek, a branch of Spoon river, while in the northwest, Cedar, Main Henderson and Pope creeks have their origin, and run to the westward.

By these, and some smaller streams, this county is well watered. Springs, though not numerous, are occasionally found along the lower lands. Good wells may generally be had at depths varying from fifteen to fifty feet.

A large proportion of the county is prairie, but so numerous are the streams that the prairies are commonly but a few square miles in extent. The soil does not present any material difference in appearance from that of the other counties in this part of the State, and is of the usual dark colored, vegetable loam, with a brown clay subsoil. That along the water courses is generally of less depth and lighter in color.

Surface Geology.

This embraces the usual subdivisions of the Quaternary, with the exception of the Loess, which was not noticed. The alluvial deposits are not extensive, seldom over a mile or so in width, and commonly much less, and comprise the bottom lands found along nearly all the water courses. The soil is a dark colored loam, frequently intermingled with sand and gravel.

The Drift is spread over the entire surface of the uplands, to a depth of from ten to sixty feet, perhaps occasionally a little more. It comprises a series of yellow and blue clays, here and there mixed with sand and gravel. Boulders of igneous and metamorphic rocks are not uncommon in it, and may frequently be seen along the courses of the streams. Wells are not usually sunk entirely through this deposit, an abundant supply of good water being commonly found before the beds of the Coal Measures are reached, though occasionally they go deeper, and good water is sometimes obtained in the Coal Measures.

All the stratified rocks exposed in Knox county belong to the *Coal Measures*, and they comprise a series of sandstones, limestones, clays, shales and seams of coal, and represent the middle and lower part of the series, from coal No. 6, of the Illinois section, to coal No. 1 inclusive.

The upper seam, No. 6, is found principally in the eastern half of the county. It varies in thickness from four to six feet, and affords a good quality of coal. In this and the adjoining counties, it has a clay band about a foot and a-half or two feet from the bottom, and frequently several other clay partings, as the two sections given below will illustrate. No. 1 was taken from a mine in section 15, township 10, range 4, and No. 2 from section 32, township 12, range 4.

	No. 1.		No. 2.	
	FEET.	IN	FEET.	IN.
1. Coal	2	10	1	8
2. Clay		¼ to ½		½
3. Coal	1		1	
4. Clay		1 " 2		3
5. Coal		8		6
6. Clay		½ " 1		½
7. Coal		11	1	

No. 4 of this section is nearly always present, but is occasionally replaced by clay shale, and rarely by pyrite. Partings Nos. 2 and 6 are quite variable, always less than No. 4 and frequently wanting or marked by a band of shale or pyrite. The principal clay parting, No. 4 of the section, is largely used as a mining seam. The clay having been removed the coal above is broken down, and that below taken up.

In the western half of township 12, range 4, this coal seam has been extensively worked. Mines have also been opened in sections 4, 5, 17, 18, 19, 29, 30, 31 and 32. A section of the strata on section 12, gave:

		FEET.	IN.
1. Clay shale. Not measured			
2. Limestone		1 to 3	
3. Slaty or clay shale	6 in. to	4	
4. Coal		2 " 2	8
5. Clay, mining seam	2 in. to		3
6. Coal	1 foot 6 in. to	2	
7. Clay		2 " 4	
8. Sandstone			

In some mines this coal runs as thick as six feet, but the section above given shows its more common thickness. At the mines of P. Peterson, Esq., in the northwest part of the northwest quarter of section 32, and some others in the vicinity, the coal was thicker than in the mines in the northern part of the township. The overlying limestone is here quite hard and durable, and is worked somewhat for building stone. In township 12, range 3, mines have been worked in sections 1, 10, 1,1 18, 19 and 20. East of Wataga, township 12, range 2, in sections 13, 15, 22, 23 and 24, much coal has been taken from this seam. From the mines of John A. Leighton, Esq., in section 12, the following section was obtained:

	FEET.	IN.
1. Clay shale. Not measured		
2. Limestone	1 foot 6 in. to 2	
3. Clay		6
4. Black slate	8 in. to 2	
5. Coal	4	2
8. Clay. Not measured		

The clay parting here varied from two to four inches in thickness. Near the center of section 24, limestone is found in considerable quantities, which makes good lime.

In township 11, range 3, there are mines in sections 3, 4 and 5, and the coal is reported to belong to this seam, and to be from four to five feet thick. In section 15, township 10, range 4, the coal appears along the bluff a number of feet above the stream. The following section was obtained here:

	FEET.	IN
1. Limestone. This is sometimes replaced by two feet of black shale	1 to 4	
2. Clay, containing limestone nodules		6
3. Coal, clay parting from one to two inches thick	5	8
4. Clay	10 " 12	
5. Sandstone	3 " 5	
6. Clay shale	8 " 12	

The limestone, No. 1 of the section, is worked at this place, and the following fossils were obtained from it: *Productus Prattenanus*, *Chonetes Flemingii*, *Yoldia Knoxensis ?* and some others not identified. This limestone is again exposed and worked in the southeast quarter of section 25, township 9, range 4. It is quite hard at this point, and makes a valuable building stone, and being four feet thick, can be quarried more readily than at most other localities in this vicinity where it is thinner. It also forms a good roof for the coal below, there being but six inches of shaly limestone between. This seam is worked in sections 23, 24, 31 and probably 32 and 33. There is also a mine in section 35, township 9, range 3. At this point the coal is found high up in the hill and is reported to be somewhat rotten.

The mines formerly worked by Messrs. Camp and Powell at Oneida, section 36, township 13, range 2, also belongs to this seam. The mine was closed at the time I was there, so that I was unable to make any examinations. The seam was reported to be quite thin, but with the usual clay parting.

The following analyses of three specimens of this coal are taken from the first volume of this report, and were made by Dr. Blaney, of Chicago:

	Weight of a cubic foot.	Moisture.	Volatile combustible matter.	Carbon in coke.	Ashes.	Coke.
1.	78.4855	12.0	27.2	55.2	5.6	60.8
2.	81.5112	8.8	30.8	58.0	2.4	60.4
3.	79.4892	11.6	29.3	55.9	3.2	51.1

No. 1 was from near the top of the seam; No. 2 from just above the clay band, and No. 3 from below this band.

This seam is only found in the higher portions of the county, which are principally in the eastern half, and north of Spoon river. The river divides this seam, leaving a small portion in the southeastern part of the county. Here it is found along Kickapoo and Littler's creeks, in township 9, range 4, and probably underlies the lands between the two in the southeastern part of the township. At a single point in section 15, township 10, range 4, there are some mines that appear to belong to this seam. North of Spoon river this seam underlies the western half of Victoria, township 12, range 4, a portion of the northern and western parts of Copley, township 12, range 3, and a part of the eastern half of Sparta, township 12, range 2.

At most of the mines in the county, this coal is of good quality, and no other seam, unless it be No. 2, furnishes as good blacksmith's coal. "Horsebacks," or slips, are not very numerous, though occasionally occurring. At present this is the most valuable seam worked in the county.

The next seam, No. 4 ? of the Illinois section, usually lies from forty to sixty feet below this one. As there is no place in the county where the two are exposed, I was unable to obtain a section of the strata between them. This coal is seldom less than three, or more than four feet in thickness. Mines, which appear to be in this seam, are worked in sections 2 and 3, township 13, range 1. A section obtained from here showed:

	FEET.	IN.
1. Limestone	1	6
2. Clay shale	8 to 10	
3. Coal	3 " 5	
4. Clay	3	
5. Sandstone. Not measured		

These are the only coal mines that have been opened in this part of the county, and there are none in the adjoining parts of Mercer and Henry counties. A mine has been opened in this seam in the eastern part of section 25, township 12, range 4. No work was being done at the time I was here, but another mine just over the line in Stark county, was open. As they are but a short distance apart, the following section, which was taken from the latter, will probably show the general character of the strata :

	FEET.	IN.
1. Limestone	3	
2. Clay shale	10 to 12	
3. Coal	4 " 6	
4. Impure cannel coal	6 in. to 10	
5. Clay. Not measured		

In the cannel coal, No. 4 of this section, there are the remains of fishes and plants, some of which are beautifully preserved, though generally quite fragmentary.

The mines along Sugar creek and its branches, in township 12, range 3, may belong to this seam, or perhaps to No. 6, but as none of the banks were open, I could not make the necessary examinations to determine this point. The coal furnished by these mines was reported to be of superior quality, and this would seem to indicate that it belonged to No. 6.

The mines in sections 9, 16 and 32, and along Middle creek and its branches, in the northeast part of township 11, range 2, also those in section 25, township 11, range 1, are probably in coal No. 4, or possibly in No. 5.

South of Spoon river, there are a number of mines along Littler's creek, in sections 26, 27, 28, 34 and 35, township 9, range 3. A section here gave:

	FT.	IN.	FT.	IN
1. Black slate	1	8 to	2	
2. Coal	3	6 to	4	6
3. Fire clay	1	6 to	2	

The mines in section 3, township 9, range 4, and sections 26 and 27, township 10, range 4, may also belong to this coal, but the evidence was quite unsatisfactory. The following section was reported from section 26 :

	FEET.
1. Sandstone	3 to 5
2. Clay shale	8 to 12
3. Clay	2
4. Black slate	2 to 4
5. Coal	2 to 3
6. Clay shale. Not measured	

This seam, though not as extensively worked as No. 6, underlies a much larger portion of the county. It probably underlies township 13, ranges 2, 3 and 4, and the eastern part of range 1.

A short distance southwest of Milroy, a thin seam was reported somewhere from twenty to forty feet below the one now worked there, which appears to be No. 6. Should this lower seam be No. 4, it is much thinner here than it is usually, and it is more probably No. 5. It probably underlies township 12, ranges 2, 3 and 4, township 11, range 2, and the southeastern part of range 1, and the northern borders of ranges 3 and 4, perhaps the eastern part of township 10, range 4, and township 9, range 4, and the southern half of range 3. The coal from this seam is generally of fair quality, but is a little harder, and not as well liked as that from No. 6.

In township 10, range 1, there is a coal seam worked in several places, which may be No. 3 (?) of the Illinois section. The exposed strata in section 23 showed the following succession:

		FT.	IN.		FT.	IN.
1.	Clay or clay shale, rotten. Not measured					
2.	Coal	4		to	5	
3.	Sandstone and shale	10		to	15	
4.	Clay shale				7	
5.	Black slate		6	to	1	3
6.	Clay shale				4	
7.	Coal No. 2	1	6	to	2	3
8.	Fire clay. Not measured.					

Abundance of fossil plants were found in some portions of the shale overlying the upper coal seam of this section, among which are, *Pecopteris villosa*, *P. polymorpha*, *Neuropteris rarinervis*, *Stigmaria Evenii*, *Sphenopteris intermedia*, *Annularia longifolia*, *A. sphenophylloides* and *Pinnularia capillacea*. All these plants are found in connection with coal No. 2 of the Illinois section, and have not hitherto been observed in connection with No. 3 in this portion of the State.

The lower seam is considered by the miners to be the same seam as that worked near Avon, ten or twelve miles southeast of this, which is referred by the best authorities to coal No. 2. The upper seam, at this place, agrees very nearly with the one found in section 17, township 8, range 2 west, in Warren county. The lower seam, No. 7 of the section, is worked in several places in section 23, but the upper one only on the farm of Deacon Andrews, in the southeast quarter of the section. The coal furnished by this mine is rather soft, kindles easily, and has a good reputation.

A portion of the mines worked in section 10, of this township, appear to be in this seam. A section at this point gave:

		FT.		FT.
1.	Calcareous clay or shale. Not measured			
2.	Coal	3	to	6
3.	Calcareous clay or shale	7	to	9
4.	Coal	5	to	6
6.	Blue clay or shale, about			20
6.	Coal			2

No. 6 of this section I consider to be coal No. 2, and No. 4 of the section to be the equivalent of the upper coal in section 23. No. 2 of this section may be only a division of the coal below it, or it may be a separate seam, perhaps coal No. 3. The equivalents of either of these seams have not been recognized elsewhere in the county.

Near the former site of Dr. E. Hall's mill, section 5, township 13, range 1, there is an outcrop of limestone along Pope creek, close to the water's edge. It is supposed that there is a bed of coal but a few feet below this, but the matter had not been thoroughly tested when I was there. Should it prove to be so, it seems quite probable that it may be the same seam, No. 3 of the general section, and the same as the upper one found in the southwestern part of township 14, range 2 west, in Mercer county. Much of the limestone at this outcrop is highly fossiliferous, and contains many well preserved remains. The following fossils were obtained here: *Spirifer cameratus*. *S. planoconvexa*, *Productus longispinus* var. *muricatus*, *P. Prattenanus*, *P. Nebrascensis*, *Chonetes mesoloba*, *Avicula longa*, *Aviculopecten pellucida*, *A. carbonarius*, *A. occidentalis*, *Lima retifera*, *Nucula parva*, *Edmondia ovata*, *Entolium aviculatum*, *Allorisma Geinitzii*, *Yoldia Knoxensis?* and *Leda bellastriata*, *Bellerophon ellipticus*, *B. Montfortianus*, *B. Meekianus*, *B. percarinatus*, *Pleurotomaria Grayvillensis*, *P. sphæruluta*, *Macrodon*, *Machrocheilus inhabilis*, *Polyphemopsis peracuta*, *P. inornata*, *Pleurophorus*, *Nautilus* and *Orthoceras cribrosum*. Of these, *Allorisma Geineitzii*, *Leda bellastriata*, *Nucula parva* and *Pleurophorus?* have been referred by Prof. Geinitz to the following European Permian species: *Allorisma elegans*, *Nucula Kasanensis*, *N. Beyrichi*, and *Pleurophorus Pallasi*. Some of these species are found in connection with the lowest coals. (See the description of coal No. 1 in the report on Warren county.) For the identification of the above named fossils, and for other points of interest, I am indebted to Mr. F. B. Meek.

The next coal seam, No. 2 of the Illinois section, is generally from a foot and a half to three feet in thickness. This coal is considered fully equal in quality to that of any other seam found in the county. In township 12, range 1, a coal that appears to be the equivalent of this seam, is worked in sections 20, 21, 29, 30, 32 and 33. The seam is from two to three feet thick, with from one to three feet of clay shale, and a band of limestone above, and a floor of fire clay. In sections 23 and near the southeast corner of 16, township 11, range 2, it is again worked. From here along down Court creek to its mouth, and on some of its branches, this seam has been more or less worked in sections 19, 22 and 23, township 11, range 3, also in sections 13 and 35. In Truro, township 11, range 4, it appears in or near the bed of Spoon river, and has been worked at various places. From here there are outcrops along the river, at intervals, to near the south line of the county. The exposure near the river bridge, section 12, township 10, range 3, shows the following succession:

	FT.	IN.	FT.	IN.
1. Clay shale. Not measured				
2. Limestone		3		4
3. Clay shale			3	

		FT.	IN.	FT.	IN.
4.	Calcareous iron ore			2	3
5.	Clay shale			2	3
6.	Limestone		6 to		9
7.	Clay shale			1	3
8.	Limestone				2
9.	Arenaceous shale				3
10.	Limestone		2 to		3
11.	Clay shale			6	6
12.	Black slate			3	
13.	Coal	1	3 to	3	
14.	Clay. Not measured				

The limestone, Nos. 2, 6, 8 and 10, contain a greater or less percentage of carbonate of iron. From the shales and limestones were obtained *Productus Prattenanus*, *P. Nebrascensis*, *Athyris subtilita*, *Chonetes mesoloba*, *Lingula umbonata*, and other fossils.

West of the river, in township 10, range 3, this seam is worked in sections 8, 16, 18, 19 and 29, also in township 10, range 2, in sections 14, 22, 23, 25, 26, 27, 29, 33 and 34. In section 33, along Hog creek, specimens of "cone-in-cone" were found in considerable quantities. West of this the coal has been found in sections 10, 14 and 23. The exposure in the bluffs of Brush creek, in the northeast quarter of section 14, gave:

		FT.	IN.
1.	Sandstone. Not measured		
2.	Shale. Not measured		
3.	Black slate. Not measured		
4.	Clay shale	6	6
5.	Coal	2	2
6.	Clay shale or clay	3	
7.	Sandstone. Not measured		

Nos. 1, 2 and 3 of the above sections were only exposed sufficiently to determine their lithological characters, but not so as to be accurately measured. The following section was obtained in section 10:

		FEET.
1.	Clay or shale. Not measured	
2.	Coal	3 to 6
3.	Clay or shale	7 " 9
4.	Coal No. 3	5 " 6
5.	Clay shale	20
6.	Coal No. 2	2
7.	Sandstone. Not measured	

Seams that appear to be the same as Nos. 4 and 6 of this section, are worked in section 23, and the plants obtained from the overlying shales of the upper bed, are the same as are found elsewhere in connection with No. 2. This would indicate that the lower coal might be No. 1 of the general section of the coal strata in the Illinois river valley, as given in the third volume of these reports, and that the others are the equivalents of coals No. 2 and 3 of the same section, to which they correspond more decidedly in their general features than with the higher beds. They are, however, considerably thicker here than coals Nos. 2 and 3 average in other portions of the State, but as the local thickening of the coal is not an uncommon occurrence, no definite conclusion can be based on that character alone. It may be, however, that the lower coal in the above section will prove to be No. 2, and that the beds above either represent coals 3 and 4, or an unusual local development and division of No. 3 only. If this proves to be the true solution of the question, it shows that the fossil plants usually found in the roof shales of No. 2, also occur sometimes in connection with the higher seams.

The lower coal in the above section is also worked in township 9, range 1, section 17, and the mines in section 36 probably belong to it. The seam there is about three feet thick. In township 9, range 2, it is worked in sections 6, 8, 9, 27 and 31. Along the little run that intersects the western part of section 31, a coal that appears to be the same has been worked high up in the bluff, and in the bed of the run the lower coal, No. 1, crops out.

No. 2 is worked either by stripping or drifting. Along the bluffs of the streams and in the hill-sides where it crops out, it is frequently the case that but a few feet of other material lies over it, and by stripping this off, large amounts of coal are obtained at a small expense. At no place in the county is this seam worked by means of a shaft, but in those parts where it attains a thickness of from two and a-half to three feet, it may hereafter be profitably worked by this method.

The lower seam, No. 1, is not worked to any extent in but one locality in Knox county, on section 21, township 12, range 1. It is here worked by means of a shaft, which is about thirty feet deep. The coal is six feet thick, but as much of the roof is not very firm, and the upper part of the coal is of inferior quality, from one to two feet of coal is left to strengthen the roof. In section 36, township 9, range 1, this seam has been found several feet below the bed of the little stream that passes through it. In section 31, township 9, range 2, it crops out in the bed of a small run, and a little coal has been taken out here. South of this, and just over the line in Fulton county, the strata exposed in the bluff of Cedar Fork show the following section:

	FEET.	IN.
1. Clay shale. Not measured		
2. Coal No. 2, about	3	
3. Shale and slate	35 to 40	
4. Coal, upper division of No. 1		10
5 Shale 8 in. to	1	2
6. Sandstone 6 "		9

	FEET.	IN.
7. Clay shale	1	
8. Black slate	3	6
3. Coal No. 1, about	3	

None of the mines in either seam were open when I was at this place, and hence I was unable to measure the coal accurately. It seems probable that this coal, and also No. 2, underlies nearly, if not the whole, of Knox county.

While the strata of the Coal Measures dip, locally, in almost every direction, they appear to have a general inclination to the southeast, save, perhaps, in the northwestern part of the county, and here I do not know the direction. The dip, however, is not regular, but seems to be quite undulating.

Coal No. 2 first outcrops in the bed of Walnut creek, in section 17, township 12, range 5, in Stark county. South of this it is not again exposed, as far as I learned, between that point and section 14, township 11, range 4, in Knox county. From this point, Spoon river, with its various windings, runs to the west for about five miles, and then south about nine miles, from whence it passes to the southwest till it leaves the county. From where this coal first appears in Knox county, it is occasionally exposed along the river and near its bed to a point a little beyond where the river turns south. In the northwest quarter of section 6, township 10, range 4, it lies low in the bed of the river, and is frequently torn up in considerable quantities by the current at high water, and is sometimes worked when the river is very low. Some two or three miles south, near the bridge, it appears a little above the bed of the river. At Burnett's mill, section 34, township 10, range 3, the coal lies some ten or more feet above the river level, but southwest of this, in section 10, township 9, range 3, it is worked in the bed of the river. In sections 26 and 27, township 9, it again appears, but how much above the bed of the river I did not learn. A mile and a-half west of this it crops out along a branch of Spoon river, about fifteen feet above its bed. South of here, this coal is not worked along the river in this county, as far as I could learn.

Economical Geology.

Stone for Building.—Knox county has but a limited supply of good building stone. Some portions, however, have sufficient for their own wants. North of Knoxville, in the western half of sections 16 and 21, township 11, range 2, quarries have been opened in a heavy sandstone bed. Some portions of the rock do not appear to be of much value, while others, though soft, form a durable material for the use of the builder. This rock appears to lie above coal No. 2, and is probably the equivalent of a similar bed, in this position, in Mercer county. In the northeast quarter of section 16, there is a quarry that affords an entirely different rock. It is a dark drab-colored conglomerate, spotted by darker slate-colored pebbles. By exposure it changes, on its surface, to a lighter and yellowish color that is mellow and pleasing in its effect. It is compact, moderately hard, and makes a valuable building stone. The foundation stone of the "fire-proof" building attached to the court house in Knoxville, was obtained from this locality.

Sections 27, 33 and 34, township 10, range 2, furnish some building stone. Some of the other localities are section 14, township 10, range 3; section 27, township 10, range 4; and sections 21, 27, 35 and 36, township 9, range 3. Some of these quarries are large, and considerable amounts of material have been taken from them.

The band of limestone which lies just above coal No. 6, and is from one to four feet thick, has been considerably worked, when so exposed as to be readily obtained. One of the largest quarries in this limestone is south of Yates City, in section 25, township 9, range 4. The bed is here four feet thick, and yields a hard, dark drab or grayish-colored, compact rock, which readily breaks into blocks of good shape for building purposes.

Limestone for Lime.—This is rarely found in any abundance. In township 12, range 2, near the center of section 24, considerable quantities of limestone are found, which is manufactured into lime, yielding a fair article. Elsewhere the manufacture has been attempted only on a small scale. For the most part Knox county has to depend upon localities more favored in this respect, for its supply of lime.

Coal.—The best and largest amount is furnished by the upper seam, No. 6. This is principally worked in township 12, ranges 2, 3 and 4, and in townships 9 and 10, range 4. This seam is from four to six feet thick, and at many of the mines it is comparatively free from foreign substances, and hence requires but little sorting. "Horsebacks," or slips, which, in some places greatly injure this seam, are not so numerous in this county as elsewhere. The coal is somewhat lighter than that from seam No. 4, and is preferred by blacksmiths.

No. 4* furnishes the northwestern part of the county with a good supply of coal of a fair quality, and the mines in this seam are among the best in the county. Nearly all the coal obtained in township 11, range 2, is, probably, from this seam, and also that from township 9, range 3. It is also worked in some other places, and affords a coal of good quality, and harder than that from No. 6. It does not kindle as easily but lasts longer, and for some purposes is preferred.

---

* It is quite probable that No. 5 is also locally developed in this county, but as there is no very decided features pertaining to this seam that will serve to distinguish it from No. 4, unless both are exposed, it is very difficult to decide positively whether an outcrop of a single seam at about this horizon, belongs to one or the other of these coals. The quality of the coal it affords is more like No. 6, while the roof shales and limestone above it, correspond more nearly with No. 4. In Fulton county, the distance between these coals, when all three are present, is only about thirty-five feet, and when No. 5 is not developed, the distance between Nos. 4 and 6 is about sixty-five to seventy feet. A. H. W.

Coal No. 3.—This is worked in township 10, range 1, and furnishes a good coal, and the larger part of the supply for this section.

The remaining portions of the county are supplied by mines which, probably, are in coal No. 2. At most places where worked, this coal is of excellent quality, and usually pretty free from admixture with other substances. It is largely used for, and well adapted to, blacksmithing purposes. Though this is the thinnest seam worked, yet the amount obtained from it is quite large.

Coal No. 1 was only recognized at one point in the county, on section 21, township 12, range 1.

From this it will be seen that Knox county is abundantly supplied with good coal, there being but three townships in which coal is not mined now, viz: township 13, ranges 2, 3 and 4, and in two of them it has been worked formerly, and probably not less than two workable seams may be found in every part of these townships.

CHAPTER XXII.

STARK COUNTY.

Stark county is bounded on the north by Henry and Bureau counties, on the east by Putnam and Marshal, on the south by Peoria, and the west by Knox and Henry. It has a superficial area of eight townships, or two hundred and eighty-eight square miles. It embraces townships 12 and 13 north, of range 5 east, and townships 12, 13 and 14 north, of ranges 6 and 7 east.

Spoon river intersects the county from north to south. In the northeastern part of township 13, range 6, the river branches—the West Fork passing through township 14, range 6, and the East Fork through township 14, range 7. In the southern part of the latter township, is Cooper's Defeat Creek. In the southeastern part of the county are Camp and Mud runs, and in the southwest is Walnut creek. Indian creek rises near the northern part of township 13, range 5, and empties into Spoon river just above Slackwater. By these and some smaller streams, this county is well watered. Springs are occasionally found along the lower lands, but are not abundant. Good wells may generally be had at depths varying from fifteen to fifty feet.

A large portion of the county is prairie, but on account of the numerous intersecting streams, the prairies usually contain but a few square miles of area. There are, however, some large prairies in township 12 and 13, range 7. The soil is similar in appearance to that of the other counties in this part of the State, and is of the common dark colored loam, which, when properly drained and cultivated, is everywhere productive. The subsoil is usually of a brown or yellow clay. The soil of the timbered lands along the water courses is usually of less depth and lighter in color.

Surface Geology.

Two of the subdivisions of the Quaternary are found in this county, Alluvium and Drift. The Alluvial deposits comprise the bottom lands found along nearly all the water courses, but they are seldom over a mile in width, and generally much less.

The Drift, which comprises a series of brown and blue clays, locally intermingled with sand and gravel, is spread over the entire surface of the uplands to a depth of from twenty to fifty feet, and perhaps in some places a little more. Boulders of the older rocks are not uncommon in it, and frequently lie scattered along the water courses. These are most commonly granite, or belong to that class of rocks closely related to it. Wells are seldom sunk through this formation, an abundant supply of good water being commonly found before the lower beds are reached.

All the stratified rocks that are exposed in this county belong to the Coal Measures, and include all the lower portion of the series, from coal No. 7 to coal 2, inclusive. Lower than this the rocks are not exposed.

Coal No. 7, of the Illinois valley section, has been found only at a few places. It has been worked in or near the north line of section 10, township 14, range 7, along East Fork. In section 10, a shaft has been sunk by Mr. S. C. Francis, which affords the following section:

		FEET.	IN.
1.	Yellow clay	2	
2.	Red sand	2	
3.	Limestone, nodular	2	4
4.	Clay, light colored	6	10
5.	Clay shale	2	
6.	Sandstone		8
7.	Blue clay shale	4	2
8.	Sandstone	1	4
9.	Blue clay shale	8	
10.	Dark colored clay shale	5	8
11.	Coal		2
12.	Blue clay shale	12	
13.	Impure limestone		3
14.	Clay shale	8	0
15.	Impure limestone		2
16.	Blue clay shale	1	4
17.	Dark colored clay shale	3	1
18.	Coal	2	7
19.	Clay, penetrated	1	8

The shaft had not been sunk any farther at the time I visited it—in the fall of 1868—neither had the coal, No. 18 of this section, been tested. This coal appears to occupy the position of coal No. 7, and probably belongs to that seam. The coal worked at the Bradford shaft, which is but a short distance from here, in section 21, is thought to lie some thirty or forty feet below, and is probably No. 6. In section 32, township 10, range 7, this coal has been worked a little, by stripping, along Mud run.

Coal No. 6 is the principal seam worked in the county. It first appears in the bluff of West Fork, in the southeast part of section 3, township 14, range 6.

From this point to the southeast quarter of section 16, it has been worked at intervals along the west bluff of the creek. At the latter place numerous openings have been made and large quantities of coal taken out. The coal here crops out of the bluff some ten or fifteen feet above the bed of the creek, is four and a half feet thick, and has a two inch clay parting near the middle of the seam. In township 14, range 7, section 28, this seam is worked at the Bradford shaft, which is located on the east bank of East Fork, and near the north line of the section. I am indebted to S. C. Francis, Esq., for the following section of this shaft:

		FEET.	IN.
1.	Yellow clay	3	
2.	Limestone	4	
3.	Light colored clay	4	6
4.	Light colored clay shale	8	4
5.	Limestone	2	4
6.	Clay shale	9	10
7.	Coal		2
8.	Soft black slate		4
9.	Clay	4	5
10.	Sandstone	22	3
11.	Clay shale	6	
12.	Limestone	4	
13.	Light colored clay shale	6	
14.	Green clay shale	2	4
15.	Dark colored clay shale	3	2
16.	Limestone, impure	1	6
17.	Dark colored clay shale	2	6
18.	Coal, with 3 inch clay parting	3 to 5	

"Horsebacks" or slips are very numerous in this mine, rendering the working of it quite expensive.

Near the junction of East and West Forks, and in the northern part of section 1, township 13, range 6, other shafts have been sunk. The shaft at Modena, in the southern part of section 1, furnished the following section:

		FT.	IN.	FT.	IN.
1.	Drift, variable				
2.	Sandstone, sometimes not present			1	
3.	Blue clay	8		to 10	
4.	Clay shale	12		to 14	
5.	Impure blue limestone			2	
6.	Coal	4	6 to	5	6

West of this, in the northern part of section 4, this coal appears in the bed of Jack creek, and has been worked a little. Farther down the creek, in sections 2, 11 and 12, it crops out along the stream, from eight to ten feet above it. A number of mines have been opened at various points in these sections.

Along a little branch that enters Spoon river, near the north line of section 14, this seam outcrops some ten or more feet above the stream. The exposure in this locality gave the following succession of strata:

		FT.	IN.	FT.	IN.
1.	Sandstone. Not measured				
2.	Clay shale	12		to 15	
3.	Impure limestone	1		to 2	
4.	Clay shale			1	6
5.	Black slate				6
6.	Coal	2		to 4	
7.	Clay, parting		2 to		3
8.	Coal	1	6 to	2	
9.	Clay or clay shale	3		to 4	
10.	Sandstone. Not fully exposed				

The black slate over the coal contains numerous fossils, but mostly imperfectly preserved. Among those obtained are, *Cardinia fragilis? Aviculopecten rectalaterarea*, *Discina nitida*, *Pleurotomaria Grayvillensis*, together with some fish remains.

No. 10 of this section is worked for building stone, and affords a fair article. The coal, and also the other strata for some distance above and below it, are well exposed in the bluff.

From this point, along the river and on the little runs that put into it, the coal has been more or less worked, until we reach sections 25 and 26, where the seam lies some twenty feet or more above the river. In section 26, on the level land and a little back from the river, several shafts have been sunk. One of the most westerly of these gave this section:

		FEET.	IN.
1.	Soil and Drift	20	
2.	"Second soil," black and very soft	10	
3.	Clay	4	
4.	Limestone	2 to 5	
5.	Sandstone	12	
6.	Clay shale	15	
7.	Limestone, containing much pyrite	1	8
8.	Black slate	1	6
9.	Coal	4 to 5	
10.	Clay	6	
11.	Sandstone, exposed	15	

A short distance to the east of this, and from about the same level, it was found necessary, in sinking a shaft, to go about thirty feet deeper in order to reach this seam. South of here, this coal is worked in section 23, township 12, range 6, when it appears in the bluff some eight or ten feet above the river. It is thinner here than at the other mines in the county, and the overlying strata are in part different. A shaft, sunk a short distance from the river, penetrated strata as follows:

		FEET.	IN.
1.	Clay and rock, mixed	21	
2.	Clay shale	8	
3.	Limestone	1	
4.	Clay shale, with usually a little black slate at the bottom, and sometimes all slate	1	8
5.	Coal, with two inch clay parting	2	6
6.	Clay. Not measured		

"Horsebacks" are very common here, and, together with the thinness of the seam, render the working of this mine very expensive. The fact that there are no other mines in this vicinity, alone renders the working of this one profitable.

Coal No. 4, of the Illinois section, has been found at but one place, section 19, township 12, range 5, where the following section was obtained:

		FEET.	IN.
1.	Limestone	3	
2.	Clay shale	10 to 12	
3.	Coal	4 " 6	
4.	Cannel coal, impure	½ "	10
5.	Clay. Not measured		

The cannel coal, No. 4 of this section, contains the remains of fishes and plants. Among the plants obtained here are *Pecopteris arborescens*, *P. oreopteridius*, *P. acuta*, *P. chœrophylloides*, *Sphenophyllum Schlotheimii*, *Sphenopteris tenella*, *Pinnularia* —, *Selaginites* —, etc. Among the fish remains found was one nearly perfect fish belonging to the genus *Paleoniscus*; also, teeth, etc. of a *Diplodus*.

This cannel coal is seldom taken up with the main coal, and still less seldom is it brought to the mouth of the mine; hence, the amount of material from which I could collect was very small. Large quantities of a good article of coal are obtained from this mine.

The next seam below this appeared to be coal No. 2, of the Illinois section. From an exposure in the bluff of Walnut creek, section 17, township 12, range 5, this section was obtained:

		FEET.	IN.
1.	Drift. Not measured		
2.	Clay and gravel stratified	3 to 5	
3.	Shale	45 " 50	
4.	Black slate	2 " 4	
5.	Coal	1	6
6.	Clay. Not measured		

This coal lies in the bed of the creek, and can be worked only at low water, most of it being covered at the time I was there. As this was the only place

I examined, and no fossils were obtained here, this seam is only provisionally referred to No. 2 of the general section. A similar seam is reported in section 17, township 12, range 6, at the foot of the bluff, along Indian creek. This outcrop has not been worked to any extent.

The general dip of the Coal Measure strata in this region appears to be to the southeast, though not uniformly, but rather in undulations.

Coal No. 6 first appears in Stark county near its northern line, in township 14, range 6. Here it lies above the creek, and continues above it to the southern line of section 16. From here it is not exposed for several miles down the creek. At Modina, section 1, township 13, range 6, it lies considerably below the bed of the river. About a mile west of here it is some ten or more feet above Jack creek, a branch of Spoon river, and farther down this creek, and near its mouth, the coal lies but little above its bed. Farther south, and a little west, in the northern part of section 14, where it is again exposed, it lies some ten or twelve feet above the river. The exposures, thus far, have all been on the west bank. Half a mile south, and near the eastern line of the section, the coal appears some distance up the bluff, not less than twenty or twenty-five feet above the river. In the northwestern quarter of section 23, it is again exposed along a little run, and but a few feet above its bed. South of here, and near the eastern line of section 26, it crops out some twenty or thirty feet above the river. On the level upland, and but a short distance from the bluff, there are two shafts. The first one is about 50 feet deep, and the other one, which is but a few hundred feet to the east, is about 3 0feet deeper, both working this same coal. South of this, I did not learn of any exposure for about five miles, when, in section 23, township 12, range 6, it again crops out some six or eight feet above the bed of the river. The course of Spoon river from here is to the southwest, and this coal seam does not, probably, again appear near the river. A statement of the workings and outcrops of coal No. 2, will be found in the report of Knox county.

Economical Geology.

Stone for building purposes.—Stark county is not very abundantly supplied with good material for these purposes. The supply is unevenly distributed, some parts being destitute, while in others there is plenty. There are but few valuable deposits of limestone in this county. In sections 21, 22, township 14, range 7, the most extensive bed is exposed. It is from six to twelve feet thick, and furnishes considerable building stone, but the layers are thin, seldom exceeding four inches, and are very uneven. The stone is of a light drab color, compact, even textured, moderately hard, and is uninjured by the weather. The following section will show the position of this limestone to the underlying coals:

	FEET.	IN.
1. Limestone	6 to 12	
2. Clay shale, not accurately measured, but supposed to be somewhere from	5 " 10	
3. Limestone	4	
4. Clay	4	6
5. Clay shale	8	4
6. Limestone	2	4
7. Clay shale	9	10
8. Coal		2
9. Clay shale	12	
10. Limestone		3
11. Clay shale	8	
12. Limestone		2
13. Clay shale	4	5
14. Coal No. 7 ?	2	7

The limestone, No. 1 of this section, is reported to make, when properly burned, an excellent lime for building purposes, being nearly equal to cement. For plastering it is not so good, being too dark colored. For this and other information, I am indebted to A. B. Abbott, Esq., of Bradford.

Of sandstone, there are a number of outcrops that have been worked in this county. In section 16, township 14, range 6, there is a bed of this material which lies some ten or fifteen feet above coal No. 6. The stone is light colored and quite soft. In section 14, township 13, range 6, there is a stratum of sandstone that lies a few feet below coal No. 6, and had furnished some building stone of fair quality. In township 12, range 6, section 14, a quarry has been opened which affords a harder stone, and is thought to be one of the best sandstone quarries in the county. West of this, in section 17, there is also a quarry which furnishes a fair article of building stone, and a dwelling house in this vicinity which was erected quite a number of years ago, the material being taken from this quarry, is still uninjured. Another sandstone quarry was reported to have been opened on Walnut creek in section 20, township 12, range 5.

Coal.—Stark county has an abundant supply of coal, which is at present derived mainly from coal No. 6. It crops out along West Fork, in Elmira township, and Spoon river, in Toulon, at intervals for about twenty miles, and can, probably, be found and worked along these streams and their tributaries, for the whole distance. This coal varies in thickness from two and a-half to six feet, seldom reaching either extreme, but averaging from three and a-half to five feet. Immense quantities of coal have been taken from this seam at its outcrops along the different streams. In Osceola township, one shaft has been sunk near East Fork, and several others are partially completed. Shafts have also been sunk at Modina, and near Wyoming, in Toulon, and at Cox's mill, in Essex township.

The coal from this mine is generally good, and easily worked. At but two mines, as far as I learned, are "Horsebacks," or slips, common. The clay band, which is usually from one to two feet above the base of the coal, and is called the "mining seam," is frequently taken advantage of by the miners, who remove it and then break down the coal from above. This seam is found throughout this coal in this region, and serves as a ready means for recognizing it, there being nothing in the other coal seams that corresponds with it.

This seam probably underlies townships 12, 13 and 14, range 7, and the eastern part of the same townships, range 6.

Coal No. 4 ? furnishes nearly all the rest of the coal used in this county, although but one mine is at present being worked in this seam, but the coal is from four to six feet thick and of fair quality, and the amount annually produced is large. This seam probably underlies the whole county, with, perhaps, the exception of a portion of townships 12, ranges 5 and 6.

A coal that is supposed to be No. 2, appears in the last named townships, and has been worked a little. Coal No. 1, which lies some forty to seventy feet below No. 2 has not been reached in this county, but it seems probable that it underlies the whole of it. This seam is generally from three to six feet thick, and the coal of fair quality.

Of the eight townships in Stark county, four of them, Osceola, Elmira, Toulon and West Jersey, furnish nearly all the present supply of coal, Essex furnishing but comparatively little, and Valley far less, and none is obtained from Penn and Goshen townships. As may readily be seen, the present yield is but a small fraction of what might be annually obtained, were the demand sufficient to justify more extensive operations. As yet there is no railroad passing within the limits of the county. But two are talked of; one of them, the Peoria and Rock Island railroad, is to enter the county not far from the line between Valley and Essex, and runs north to near Wyoming, and from thence northwest through the city of Toulon, to Galva, in Henry county. The other, the Dixon, Peoria and Hannibal railroad, is to enter the county near its northeastern corner, and passes south to Bradford, and from thence in a southwesterly direction to Princeville, Peoria county. Both of these roads will pass through more or less of the coal field underlaid by No. 6, especially the one last named. It seems probable that anywhere in this county, along the proposed line of the Dixon, Peoria and Hannibal railroad, shafts may be sunk, and reach this upper seam at depths not exceeding one hundred and thirty feet. According to the miners' estimate, there are one million tons of coal to the square mile for every foot of thickness of the seam. Coal No. 6 is generally from four to five feet thick, but supposing that it will average only three feet, this will give over one hundred million tons of coal to either of the three eastern townships

Timber, Soil and Agriculture.—Along the water courses, there is usually a variable belt of timber, consisting principally of the common varieties of oak, hickory, ash and maple, black walnut, butternut, cottonwood, sycamore, coffee tree, buckeye, box elder, redbud, wild plum, cherry and crab apple. The soil of these timbered lands is a clayey loam, sometimes resembling that of the prairie, though generally lighter colored and of less depth, but frequently partaking largely of the character of the subsoil, and of a dark brown or yellowish color. Though much less fertile than the prairies, these lands are better adapted to the cultivation of fruit.

The soil of the prairies is a dark-colored loam, which contains a large percentage of humus. Its peculiar character is due to the admixture with the finely comminuted matter, which constituted the surface of the Drift, of the material resulting from the growth and decay, for long ages, of animal and vegetable substances upon its surface. If properly drained and cultivated, the prairies are everywhere productive. Drainage renders the soil dry enough for working earlier in the spring, and later in the fall; makes it warmer at those periods, when warmth is most needed; helps, by admitting the atmosphere, to prepare the mineral food for the nourishment of the growing plants, and renders the latter less liable to injury from drought.

CHAPTER XXIII.

WOODFORD COUNTY.

Woodford county is bounded, on the north, by Marshall and LaSalle counties; on the east, by Livingston and McLean; on the south, by McLean and Tazewell; and on the west, by the Illinois river. It is quite irregular in outline, and comprises a little over fifteen townships, or about five hundred and fifty-six square miles.

The most important stream in the county is the Mackinaw river, which intersects the southern part from northeast to southwest. To this, Panther and Walnut creeks are tributary, the former rising in township 27, range 2 east, and the latter in township 27, range 1 west. The two forks unite in the southern part of township 27, range 1 east, and, running a little to the west of south, enter the Mackinaw in the southeastern part of township 26, range 1 west. Walnut creek rises in township 27, range 2 west, and empties into the Mackinaw about four miles below the mouth of Panther creek. In the northwestern part of the county, are Richland and Partridge creeks, which rise, respectively, in townships 28 and 27, range 2 west, and empty into the Illinois in township 28, range 3 west. Only the southern and western portions of the county are even comparatively well watered by these streams, and there are but few springs within its limits. Good wells may generally be obtained at a depth of from fifteen to fifty feet, but in some cases much difficulty is experienced in finding water even at the latter depth.

The larger part of the county is prairie, and the surface is, for the most part, gently rolling. In the southern portion of the county the surface becomes more broken and hilly, and the prairies of much less extent, while in the western part, along the Illinois bluffs, and for some distance back, there is little or no prairie land, and the country is quite broken and intersected by deep ravines.

The soil of the prairies is a black loam, usually from one to three feet deep, and sometimes even more, with a yellow or brown clay subsoil. Timber originally skirted, for the most part, the ridges along the water courses, and along their summits and steep slopes, the subsoil comes near the surface, and the soil is usually of a lighter color. Much of the timber has been cut away since the first settlement of the county, and the process of denudation is continually going on.

The principal varieties of timber noticed on the level portions of the timbered lands were white, red, black and laurel oak, and shell-bark and bitternut hickory, and along the slopes of the bluffs and in the valleys of the small streams, there are, in addition to those above mentioned, sugar and white maple, box elder, black walnut, butternut, white and red elm, mulberry, wild cherry, sycamore, cottonwood, white and blue ash, hackberry, and red-bud, with an undergrowth of sumac and hazel.

On the bottoms of the Illinois river, we find white elm, willow, buckeye, black ash, cottonwood, and in the dryer portions the common varieties of oak and hickory, sycamore, and a few other kinds.

Surface Geology.

This comprises the usual subdivisions of the Quaternary, Alluvium, Loess and Drift. The most extensive alluvial deposit in this county is on the western border, along the Illinois river. It extends from the norh line of the county to Spring Bay, with an average width of about two mils. South of Partridge creek, it becomes narrower, and gradually decreases iwidth, till at Spring Bay the bluff comes nearly to the river, leaving but a ve narrow strip of bottom land. Along the river much of this land is wet, and on valuable, at present, for its timber, as it is subject to overflow at every consiable rise of the river. Occasionally there are low ridges that run nearly to e river, and here the land, together with that nearer the bluff, is valuable. he soil is a black, peaty loam, somewhat mixed with the sediment deposited high water, and occasionally with fine gravel and sand. It is very fertil d produces large crops when sufficiently raised above the river.

Along the valleys of the small water courses, there are ge lly some alluvial dsposits, but they are quite limited in extent, seldom ex ng a few rods in width. The soil is a dark colored loam, intermingled wit d and gravel.

Loess.—In township 28, range 2 west, on Richland creek posit of sandy clay was found which contained fresh water shells, prob f existing species, but this bed appeared to underlie the yellow clays o Drift, and will be noticed under that head. It is probable that the Loess the bluff of the Illinois, at least in places, but no point was observed wh ould be identified with certainty.

Drift.—The entire surface of the uplands of the cou e covered by accumulations of this age, which attain a thickness of fr to one hundred and twenty-five feet. These deposits comprise a serie llow, brown and blue clays, sand and gravel. At Minonk, township 28, range 2 east, a shaft has been sunk, from which the following section of the Drift was obtained :

	FEET.
1. Soil	2
2. Yellow clay	14
3. Blue clay	18
4. Sand and gravel	15
5. Cemented sand and gravel	76
	125

In section 21, township 28, range 2 west, the Drift exposed in the ravine of Richland creek, presented a different order of arrangement. A section here showed :

	FEET.	IN.
1. Soil and yellow clay. Not measured		
2. Purplish clay or hard pan. Not measured		
3. Blue sandy clay, containing fresh water shells	6	
4. Rotten drift-wood or peaty matter	3	6
5. Blue clay	3 to 4	
6. Drift-wood or peaty matter	5 " 6	
7. Blue clay. Not measured		

In this vicinity, on the uplands, wells are reported to have been sunk to a depth of from fifty to sixty feet, and the hard pan or purple clay not reached. Judging from the hight of the bluff, I should think that Nos. 1 and 2, of the last section, would probably exceed these figures.

No. 3 contained fragments of fresh water shells, among which the genera *Succinea* and *Limnea* were recognized by Mr. Meek. This bed resembles the Loess, but its position, below a considerable portion of the Drift, shows that it belongs to an older formation.

No. 4 resembles peat, and contains fragments of wood, some of which are well enough preserved to be recognized, but the larger portion has been converted into peaty matter. Among the specimens collected from this bed, the following kinds of timber were recognized by Prof. Lesquereux: American white birch, black or double spruce, American larch or Tamarach, and one variety of cedar.

No. 5 resembles No. 3, but no shells were noticed in it.

No. 6 is similar in character to No. 4. This bed was not as well exposed as the upper one, it was examined by boring through it. Of course, but small specimens could be secured by this method, and the only kind of wood thus obtained, that could be recognized, was the American or black larch.

These beds appear to have been formed mainly of drift wood, the larger part of which has undergone a partial decomposition. There is too large a percentage of earthy material intermingled with the peaty matter to be valuable for fuel. It might, however, be used as a fertilizer, and where it crops out so as to be readily obtainable, may prove of value. The material of both beds has the odor of well decayed manure.*

No. 7 resembles the ordinary blue clays of the Drift period. I am indebted to Mr. Wm. Rice, who resides in the neighborhood, for assistance in examining these beds. The peaty layers have been examined, for some distance, by him.

A bed of light colored sand, of considerable extent and thickness, is reported to lie in the Illinois bluffs in the northern part of township 28, range 3 west. It is said to be too fine to make good mortar, and may prove valuable for glass making.

Boulders of various kinds, and varying from a few inches to several feet in diameter, are found in the Drift. They consist of granite, syenite, porphyry. trap, hornblende, quartz, limestone, etc., and occasionally a specimen of native copper.

Coal Measures.—All the stratified rocks exposed in Woodford county, belong to the Coal Measures, and they crop out in but very few places. In section 1, township 27, range 3 west, about four miles northwest of Metamora, some beds of limestone are exposed, for a short distance on Partridge creek. The upper layer is a compact rock, and makes a good building material, but only about three feet in thickness of this was to be seen. The only fossils I obtained from it were, *Productus longispinus*, and *Athyris subtilita*. The lower rock is of poorer quality, and breaks badly on being quarried. From this I obtained a large *Aviculopecten*, species not known.

Near to this, a shaft has been sunk over one hundred and thirty feet, and a boring was made nearly eighty feet further. The shaft is located at the foot of the bluff, which is some sixty or eighty feet high. The rocks penetrated give the following section:

	FEET.	IN.
1. Drift	5	6
2. Clay shale	19	
3. Sandstone	6	
4. Clay shale	4	
5. Sandstone	7	6
6. Clay shale	4	6
7. Sandstone	1	
8. Slate	5	
9. Coal	1	

---

*These beds are, undoubtedly, the equivalents of similar strata passed through in the shafts at Bloomington, at a depth of about two hundred to two hundred and fifty feet below the surface, and being entirely below the true boulder clay, or Drift proper, they may be considered as stratified Post Tertiary deposits, representing the ancient soils and surface conditions, that obtained anterior to the Drift epoch. A. H. W.

	FEET.	IN.
10. Clay shale	56	
11. Sandstone	15	
12. Coal		8
13. Sandstone	5	
14. Coal	3	6
15. Clay shale	5	4
16. Sandstone	4	2
17. Clay shale	5	
18. Limestone and chert	1	1
19. Black slate	6	2
20. Clay shale	14	7
21. Sandstone, fine grained	31	
22. Black slate	4	8
23. Coal		10
24. Clay shale	6	1
25. Sandstone	?	
	212	2

No. 14 is the coal seam worked at this shaft. The larger part of it furnishes a very poor quality of coal, there being only about nine inches near the middle of the seam that is good. The lower part of it contains considerable pyrite, the "sulphur" of the miners, but by mixing the good with the poor, the whole is made saleable. As the expenses of mining this coal are considerable, a high price has to be charged for it, and at present there are no other coal mines nearer Metamora than those opposite to Peoria, in Tazewell county. Should another shaft, furnishing better coal, be opened in the vicinity, the working of this would have to be abandoned.

The fossils found in connection with this seam are, *Chonetes mesoloba*, and *Rhynchonella Osagensis*. These are abundant, and fragments of others were noticed.

The journal of the shaft was obtained for this report by Dr. J. M. Clark, of Metamora. A boring was made from No. 14 to No. 25, to learn if a better seam could not be found. This part of the section was furnished me by the foreman, Mr. Aiken.

Coal has been mined in but one other place in the county, which is at Minonk. This place is located on nearly the highest land in the county, and the shaft was sunk on the prairie, near the railroad, and about on a level with the town. The most of the following section was furnished me by the Superintendent, Mr. Atherton; the remainder by D. C. Taft, Esq.:

	FEET.	IN.
1. Drift	125	
2. Limestone	6	
3. Clay shale	3	
4. Black slate	1	

		FEET.	IN.
5.	Blue clay shale	7	
6.	Red clay shale	3	
7.	Limestone	1	
8.	Clay shale	18	
9.	Limestone	1	
10.	Sandstone	14	
11.	Clay shale	10	
12.	Arenaceous shale	7	
13.	Black slate	8	
14.	Blue clay shale	9	
15.	Red clay shale	13	
16.	Sandstone	100	
17.	Black slate	3	
18.	Clay shale	2	
19.	Coal	8	
20.	Clay	12	
21.	Arenaceous shale	6	
22.	Argillaceous limestone	2	
23.	Arenaceous shale	30	
24.	Coal		2
25.	Clay	6	
26.	Arenaceous shale	33	
27.	Black slate	19	
28.	Sandstone	12	
29.	Limestone	2	
30.	Clay shale	18	
31.	Limestone	2	
32.	Sandstone	6	
33.	Clay shale	18	
34.	Chert		9
35.	Clay shale	18	
36.	Black slate	2	
37.	Clay shale	14	
38.	Sulphur rock	1	
39.	Black slate	5	
40.	Clay shale	7	
41.	Black slate		
42.	Coal	3	10
		546	9

As the shaft had been sunk sometime before I visited it, much of the material taken out was covered up, and many of the fossils had been carried away. Crinoidal stems were abundant in some of the upper beds, but the exact horison from which they came I did not learn.

No. 2.—This is the thickest bed of limestone that was found in sinking the shaft. In it were, *Productus longispinus*, *P. Pratteniunus*, *Athyris subtilita*, and *Platyostoma Peoriensis.*

No. 7 contained *Productus longispinus*, *Syntrielasma hemiplicata*, and a coral, probably a *Cyathaxonia.*

No. 19.—This coal corresponds with that worked at the Metamora shaft, No. 14 of that section, and like that, the upper and lower portions are impure, only about nine inches of the middle being good. After working this seam for a short time it was abandoned, being unable to compete in the market with the superior Vermilion coal brought here by the railroad. This seam is, probably, No 6 of the Illinois section. A boring having been made to No. 27, and a portion of it mistaken for coal, the shaft was sunk through it into No. 28.

No. 22.—This is the only limestone penetrated by the shaft below the coal. Only a small piece of this limestone was obtained, but in it we recognized two species of *Productus*, and a *Chonetes.* The remainder of the section, from No. 28, was obtained from the journal of a boring.

No. 24, is probably the representative of coal No. 5 of the Illinois section, though this is by no means certain. No. 38 was called by the miners "Sulphur rock." I was unable to learn anything further about it.

No. 42. *Coal.*—This is supposed to be coal No. 2 of the Illinois section, and corresponds with the lower LaSalle coal. This has only been reached by boring. Work has ceased at this shaft for the present, but it is reported that it is to be resumed hereafter.

Economical Geology.

Stone for Building.—The supply of this material is very limited, there being but very few outcrops of rock within the limits of the county. Southwest of Secor, in sections 23 and 24, township 26, range 1 west, there is an outcrop of limestone. The lower part of the quarry was filled with water, so that I was unable to learn upon what the limestone rests, or how thick it is, but it appears to be somewhere from eight to twelve feet. It is of a bluish-gray color, streaked with white, and for the most part, compact. It appears to have been at one time celular, and the white portions have resulted from the infiltration of colorless carbonate of lime. In some portions of the strata the cavities still remain, and are coated with crystals of calcite, with, occasionally, pyrite. The rock contains a few fossils, among the most common of which are the following: *Productus longispinus*, *Athyris subtilita*, and *Cyathaxonia prolifera?* These quarries furnish a considerable quantity of good building stone, which, from its scarcity in this vicinity, is quite valuable. The rock makes good lime, and the fragments from the quarries might be utilized in this way.

South of Versailles, in section 33 of this township, there is another quarry, the rock from which is reported to be similar to that above mentioned. Some small exposures of limestone are reported along the Mackinaw river, but whether in Woodford county or beyond its limits, I did not learn. There is an outcrop of limestone a few miles northwest of Metamora, in section 1, township 27, range 3 west. This exposure has been described in the preceding pages.

Coal.—The supply of this important mineral is quite limited. The only mine that is worked at present, is the one northwest of Metamora in section 1, township 27, range 3 west. The seam worked here is probably coal No. 6 of the Illinois valley section. So far, this coal has been tested at two places in this county, and at each it is from three to three and a-half feet thick, and there is a band about nine inches thick near the middle of the seam, that furnishes an excellent quality of coal, while that above and below is very poor. A boring was made from the bottom of this shaft, to see if a more valuable coal could not be found. Coal No. 4 (?) was struck about seventy feet below, but was only ten inches thick. The next seam, if No. 3 is absent here, would be No. 2, and probably lies about one hundred and fifty feet below this.

This lower coal, No. 2, has been reached at Minonk, by sinking a shaft about four hundred and forty feet and boring about one hundred feet farther. The coal was found to be three feet ten inches in thickness. This seam probably underlies the whole county at a depth of from three hundred to five hundred and fifty feet. Elsewhere, coal No. 4, numbered 24 in the section of the Minonk shaft, may be thick enough to be of some value. In the LaSalle section, reported by H. C. Freeman, this seam is from three to six feet thick.

Though coal cannot be obtained in this county, except by means of shafts sunk to a considerable depth, still it can be furnished from abroad to those along the line of the railroads at reasonable rates, and hence deep mining has not been largely undertaken.

Soil and Agricultural Products.—The soil of the prairie is usually of a black or dark brown color, and from one to three or more feet deep. Its dark color shows it to be largely composed of humus, which has resulted from the growth and decay of vegetable and animal matter upon the surface for long ages. This admixture of organic matter with the finely pulverized mineral matter, which constituted the upper surface of the Drift, when it emerged from the waters in which it had accumulated, was necessary in order to form the fertile soil which now constitutes the surface of our prairie lands. The brown clays, which lie immediately below this vegetable mould, and forms the subsoil, do not readily absord the excess of moisture which filters through the soil, and hence the surface is frequently rendered too wet, where it is level or but slightly rolling, as is the case over a considerable portion of this county, to be successfully cultivated without artificial draining. It is true, that by waiting a little later in the spring, the soil can then be worked, but that gives so much the less time for the crop to ripen, and if the frost comes early it is likely to be injured, if not entirely lost. By proper drainage this would be, in a large measure, remedied, the soil made warmer and more productive, and the growing season rendered somewhat longer. In most places there is sufficient descent towards the streams, so that drains can be made with but little difficulty. Frequently, the partial or entire saving of a crop would result from a thorough drainage of the surface. Wheat, corn and hay are the principal products of the prairie, but other grains, and fruits, adapted to the climate, may be grown with more or less success.

In the vicinity of the water courses, the land is more rolling and hilly, and the subsoil comes nearer the surface, and a portion of the humus has been washed out of the soil, leaving it much less fertile, but better adapted to some kinds of crops, particularly fruits. For ordinary purposes these soils require little or no draining. In their uncultivated state they produce good timber: the common varieties of oak, hickory, elm and ash, sugar and white maple, wild cherry, black walnut, butternut and hackberry.

Along the Illinois river bluffs, grapevines are very abundant, more so than I noticed elsewhere. I saw but few vineyards in the portions visited, but the abundance and luxuriance of the wild vines would seem to indicate that here is a favored locality for the culture of the grape. Along these bluffs but little draining would be necessary, though in most places where the grape has been successfully cultivated, it has usually been found to pay to underdrain even where the soil appeared, to the unpracticed eye, dry enough. Underdrains are profitable, not only to carry off the surplus moisture, but also to give the atmosphere a chance to act more readily and thoroughly upon the subsoil. This action is necessary to assist in dissolving and preparing the mineral food for the vine, which sends its roots deep into the surrounding soil for this very nourishment.

The finest apple orchards in the county are found on these "barrens," and most other kinds of fruit succeed best on this kind of soil.

PART II.

PALÆONTOLOGY OF ILLINOIS.

SECTION I.

DESCRIPTIONS OF FOSSIL VERTEBRATES.

By J. S. NEWBERRY and A. H. WORTHEN.

INTRODUCTORY REMARKS.

Since the publication of the second volume of the Geological Survey of Illinois, in which descriptions and figures of one hundred and eighteen species, and several new genera of fossil fishes were given, the collections from various portions of the State, brought in by those engaged in field geology, have added largely to the number already known of this most interesting group of fossils, and we are now enabled to present figures and descriptions of thirty-two new species and four new genera, embracing some of the most remarkable forms yet found in the Carboniferous system.

The *Edestus Heinrichsii*, figured on Pl. 1, fig. 1, was found by Mr. John P. Heinrichs, in the Belleville coal seam at Belleville, in St. Clair county, and is, perhaps, the most remarkable fossil of its kind at present known, and its study has enabled us to throw some additional light on the probable position and use of these remarkable serrated spines in the animal economy.

The Belleville coal is usually quite regularly stratified, the layers varying from six to fifteen inches in thickness, and separated by a thin parting of bituminous shale or slaty coal, and it is probable that this fossil was embedded in one of these shaly partings between the layers of solid coal. The fauna of this coal is eminently marine in its character, and the following named species of Brachiopoda are abundant in the roof shales and limestones associated with it, in St. Clair county: *Productus longispinus* var. *splendens*, *P. Prattenianus*, *P. Wilberanus*, *P. costatus*, *P. punctatus*, *Athyris subtilita*, *A. Royissii*, *Spirifer cameratus*, *S. lineatus*, *Chonetes mesoloba*, and *C. granulifera*, associated with plates and joints of *Crinoidea*. Moreover, it is not uncommon to find this coal directly enclosed between beds of marine limestone, with only a few inches of shale or clay intervening between the limestone and the coal. The limestone beneath the coal is generally nodular and argillaceous, and contains *Chætetes milleporaceous*, two or three species of *Naticopsis*, several species of *Pleurotomaria*, and a few Brachiopoda, among which, *Spirifer lineatus*, *S. cameratus*, and *Athyris subtilita* are the most common. No remains of fishes have yet been obtained from these limestones in St. Clair county, and the only ichthyic remains yet found in the bituminous roof shales of this coal at other localities, are *Petrodus occidentalis*, and spines like that figured on Pl. II, fig. 3 and 3 a, under the name of *Listracanthus histrix*.

The occurrence of the so-called dermal plates of *Petrodus*, with the peculiar spine above referred to in the same stratum, would seem to indicate that they might have once belonged to the same species of fish, and this supposition seems to be strengthened by the fact, that while these two forms are tolerably abundant at some localities, all other traces of vertebrata are exceedingly rare in the roof shales of this coal.

The large spines, *Physonemus gigas* and *Ctenacanthus Mayi*, represented on Pl. II, figs. 1 and 2, were obtained from the upper division of the Burlington limestone, the former from the quarries near Thayer's distillery, about one mile below the City of Quincy, and the latter from Burlington, Iowa. More recently we have obtained another specimen of the last named species from the same limestone on Cedar creek, in Warren county, Illinois. The specimen of *Physonemus*, the only one at present known, so far as we are aware, in America, was found in the debris of the quarry, and the stratum in which it was originally embedded, could not be positively identified, but the *Ctenacanthus Mayi* was obtained from the limestone layer known as the "*fish bed*" in the upper division of the Burlington limestone.

The remainder of the ichthyic material, still in hand, and upon the investigation of which we are now engaged, indicates that this department of palæontology is by no means exhausted in this State, and we hope to present in a subsequent volume of this report, some ten or twelve additional plates of these very interesting fossils, illustrating at least fifty or sixty additional species, which will enable us to extend our catalogue to something over two hundred species of fossil fishes from the Carboniferous system alone, showing that our western localities of Coal Measure and Lower Carboniferous limestone strata, are far more productive in this interesting group of fossils than any other portion of the earth's surface hitherto explored. A. H. W.

GENUS PLATYSOMUS, Agassiz.

PLATYSOMUS CIRCULARIS, N. and W.

Pl. iv, fig. 2.

FISH small, two inches long, nearly orbicular in outline, head elongated, acute, granulated, nearly as long as body. Tail very heterocercal, with thirty or more rays; vertebral column prolonged to the extremity of upper lobe; lower lobe strongly marked, dorsal and anal fins opposite, set far back, broad, extending nearly to caudal fin, each highest anteriorly, anal with about thirty, dorsal with forty rays; rays supported by strong interspinous bones. Scales oblong in outline, smooth, those on the sides three to six times as high as long.

The discovery of this little fish in the Coal Measures of Illinois, is a fact of great geological interest, as the genus has not before been found in America. In the old world, most of the species are found in the Permian, but a number have also been taken from the Coal Measures near Leeds, England.

From these, the species before us is apparently distinguished by its small size, more orbicular form, and broader dorsal and anal fins.

Formation and locality : Nodules of iron ore; Mazon creek, Grundy county, Illinois.

GENUS PALÆONISCUS, DeBlainv.

PALÆONISCUS GRACILIS, N. and W.

Pl. iii, fig. 4.

FISH of very small size; body cylindrical and slender; head one-fifth of the entire length, rounded and obtuse anteriorly; mandibles and maxillaries ornamented with fine raised lines; cranial bones tuberculated (?); dorsal and anal fins placed far back and accurately opposite; ventral fins set about the middle of the body; scales rhomboidal, of nearly uniform size—except on the tail, smooth on surface and margins.

This elegant little fish seems to be quite distinct from any heretofore found in this country. It is much less in size than any species of the genus before known, sometimes hardly exceeding an inch in length. The body is elongated and narrow, bearing simple polished scales. The dorsal and ventral fins placed so near the caudal as to almost reach it when collapsed, and are exactly opposite. In this character it is unlike any other species known.

It might be inferred that this was but the young of *P. peltigerus*, N., the most common species in the Coal Measures of the Western States, but it wants the row of large scales which cover the dorsal line of that species, and also differs from it in the position of the fins and the smooth scales. In size it is about equal to *Eurylepis minutus*, N., found in the cannel coals of Ohio, but is more slender, has the fins differently placed, and wants the high side-scales of that species.

Formation and locality: Coal Measures; Mazon creek, Grundy county, Ill.

GENUS AMBLYPTERUS.

AMBLYPTERUS MACROPTERUS ? Ag.

A somewhat shattered nodule of clay ironstone obtained by Mr. S. S. Strong, from the Coal Measures at Mazon creek; contains an unmistakable impression of a species of *Amblypterus*, the first that has been recognized in America. From the mutilated condition of the specimen, it is impossible to decide with certainty whether it was or was not identical with either of the species found in the Coal Measures of Europe, but it so closely approaches *A. macropterus*, Ag., so abundant in the similar nodules of ironstone at Saarbruck, that we are not justified in giving it a new name. Other specimens, which it is to be hoped will be discovered in the locality that has furnished this, will doubtless decide the question. In either case, this adds another to the list of genera and species found in that wonderful deposit of Mazon creek, and affords additional evidence of the minute and exact parallelism between the Coal Measures of Europe and America. While we may leave the correspondence between other parts of the geological column on the two sides of the Atlantic open to further proof as to whether they be cases of homotaxis or synchronism, we must insist that here, at least, the phenomena were coincident in time, and are due to cosmical and not to local causes.

The specimen of *Amblypterus* before us, though so imperfect, shows some points in the structure and habits of the genus which have been long misunderstood. Agassiz says of the dentition of *Amblypterus*, that the teeth are *en brosse*, and hence it was a vegetable eater; but in these specimens the mandibles are distinctly shown, bearing on the outer edge of each a row of relatively large and acute teeth, such as could only be intended for the use of a carnivore. Probably, as in analagous fishes, the jaw bore smaller teeth within, but the large ones are as distinct, and relatively as large as those of *Lepidosteus*. The dentition is even better shown in some specimens of *Amblypterus* from Saarbruck in the possession of one of the authors, and these exhibit precisely the character described above.

GENUS RHIZODUS, Owen.

RHIZODUS RETICULATUS, N. and W.

Pl. iii, fig. 9, 13, 14.

SCALES of large size, oblong or oval in outline, anterior extremity somewhat pointed, posterior end truncated; margins bordered by a distinct radiate-striated band, broadest on the anterior and posterior extremities, and marked by numerous imperfectly parallel and concentric plications or lines of growth; under surface nearly smooth, with a subcentral tubercle; upper surface, within the marginal band, covered with an irregular reticulation of raised lines, which enclose elongated polygonal areolæ; on the exposed anterior third of the scale, these lines are more or less broken into rows of minute tubercles.

The elongated form of these scales is their most striking character. This is best shown in some of the smaller specimens, which are more than twice as long as broad, and spatulate in outline. The largest ones are two and a-half inches long by one and one-quarter broad. The scale is thin, and the ornamentation delicate, similar in style to that of *R. occidentalis*, but less strong. In that species, the scale is much more rounded, the two diameters being nearly equal.

Formation and locality: Coal Measures; Mazon creek, Grundy county, Ill.

GENUS EDESTUS, Leidy.

EDESTUS HEINRICHSII, N. and W.

Pl. i, fig. 1*a* and 1*b*.

SPINE robust, one foot or more in length by two and a-half inches wide, and one and a-quarter inch thick, composed of dense, bony tissue, symmetrically flattened, with an ovoid section below, lenticular above; one margin nearly straight, the other gently arched; the basal end irregularly rounded off; the arched border set with nine large, triangular, flattened, doubly crenulated, enamelled denticles, each about an inch in hight; the upper half of the straight side forming a sharp cutting edge. The denticles of the arched border are broadly triangular in outline, rising perpendicularly from the curved edge on which they rest, each three-quarters of an inch in hight by one and a-quarter inch in breadth, compressed laterally, with crenulated cutting edges. They are contiguously placed, and each is embraced by the acute prolongations of the enamelled base of the superior denticle which reaches back to its middle point. The spine is segmented throughout, each segment bearing a denticle; the segments overlapping to such a degree that the one bearing the superior denticle reaches two-thirds of the distance from the summit to the base of the spine.

By a glance at the figures now given of this fossil, it will be seen that it is generically identical with that described by Prof. Leidy, under the name of *Edestus vorax*, (Jour. Acad. Nat. Sciences, Phil., 2d series, vol iii, p. 159, Pl. 15). The fragment upon which Prof. Leidy based his description was, however, exceedingly imperfect, and left much in regard to the complete form, as well as relations of this fossil, to conjecture. Though noting its anomalous structure, Dr. Leidy was constrained to regard his specimen as the fragment of a jaw of a plagiostomous fish. No other conclusion was fairly deducible from the fragment which he had, or his proverbial acuteness and knowledge of comparative anatomy would have led him to it. Yet the specimen before us, which is nearly complete, exhibits features that seem to be incompatible with that conclusion, and indicates that it was rather a defensive spine. Although the denticles which crown its convex margin have the general form and crenulation of the teeth of *Carcharodon* or *Hemipristis*, their structure is, in many respects, quite different.

1st. The teeth of none of the sharks are symmetrical, but the anterior face is flattened, and the posterior is more or less arched, while on the denticles of the specimen before us the two sides are equal.

2d. The jaws of sharks are cartilagenous, holding the bony and enameled teeth only by ligamentous attachments, so that in the fossil state the jaws have usually quite disappeared, the teeth being scattered about in all directions, whereas in *Edestus* we have a mass of dense bone to which tooth-like denticles are united by a firm, bony anchylosis.

3d. The form of this fossil, as shown by the nearly complete specimen before us, is wholly unlike that of any jaw of fish, reptile or mammal known, being roughly rounded below, above terminating in an acute point, its upper portion flattened, smooth, even-polished, evidently never having been covered by the integuments, and is bordered on one side by a sharp cutting edge, on the other by crenated denticles.

4th. The rounded, roughened base proves that it could not have been articulated with any bones, and scarcely with cartilages, else we should have some evidences of co-adaptation. In this respect, it resembles most the dorsal spines of sharks and skates, which are implanted in the integument of the back, have a roughened base and a bony structure, with various forms of enameled denticles on one margin.

It is apparent that this fossil is generically identical with that exhibited at the ninth meeting of the Am. Ass. by Prof. Hitchcock, and of which a better figure is now given than any heretofore published. That specimen was found in the coal of Parke Co., Ind., and when exhibited to the Am. Ass. was considered by Prof. Agassiz as a jaw; one of a pair placed on the sides of the head, and compared to the embryonic condition of the saw of *Pristis*. There are, however, some features in the specimen before us, which seem to militate against that conclusion:

1st. The tissue of the rostrum of *Pristis* is only partially ossified, while this is all dense bone.

2d. The denticles of the rostrum in *Pristis* are set in alveolar cavities, while in this fossil they are inseparably united with the bony mass without sockets.

3d. If the fossil was the homologue of the rostrum of the saw-fish, the base would have presented some evidence of articulation with the bones or cartilages of the head, whereas it is rounded as though it had been completely buried in soft tissue.

4th. If it were the homologue of the embryonic half of the rostrum of *Pristis*, it must have been placed on the side of the snout, separated from its fellow, as it shows no points of contact; on the contrary, a cutting or serrated edge at the summit. On this supposition, its flattened sides must have been more or less horizontal, but if that had been its position, the upper and lower sides would hardly have been equally arched, and the organ transversely symmetrical.

We are, therefore, driven by this perfect bi-lateral symmetry to suppose this was not one of a pair, but that it stood alone, somewhere in the medial line, either as the homologue of the sword in *Xiphias*, or of the rostrum in *Pristis* (in which case it should have had an articulated base); or, as the homologue of the dorsal spines of *Chimæra*, *Spinax*, *Hybodus*, *Ctenacanthus*, etc., or the caudal spine of *Trygon* and the other Sting-Rays.

There are one or two anomalous features in this fossil which require notice: and first, there is no distinct line of demarcation between the exposed portion and that buried in the integuments, though it is plain to see that the roughened, knobby, basal portion was implanted in tissue, while the smooth, polished, and keen-edged upper portion was as certainly exposed. In most fin spines of sharks and rays, the line of the dorsal surface is very plainly marked. This is not always the case, however, so that no great importance can be attached to that feature. Another peculiarity of this spine is the comparative insignificance in size of the medullary cavity. In the great spines of *Hybodus*, *Gyracanthus*, *Oracanthus*, etc., the medullary cavity is very conspicuous, but in *Edestus* it is hardly observable, and the basal extremity, which in most species of *Hybodus*, etc., is a mere shell, is here quite solid. In some of the spines of rays, however, there is scarce any medullary cavity, so that this feature need not be considered incompatible with the conclusion that our fossil is a spine.

The segmented structure of the fossil is its most marked and anomalous feature, but one equally so whether it be considered spine or jaw, and for which no parallel suggests itself. It is undoubtedly to this structure that we must ascribe the absence of a large medullary cavity, as each segment seems to have been nourished somewhat independently of its fellows.

It is also evident that this spine was implanted in the integuments at a low angle, and that an investing skin or other nutrient tissue covered fully half its surface, on the lower portion reaching up to the enameled bases of the denticles. This is the relative position of the defensive spines of rays, to which an analogy is suggested by this character.

In some plagiostomous fishes, a bone is found quite buried in the integuments of the back, and which is a rudimentary representative of a posterior dorsal fin; it is, therefore, not impossible that we have in the fossil before us, a higher development and special modification of that organ.

On comparing the specimen under consideration with that described by Prof. Leidy, it will be seen that ours is less robust; that the segments overlap to a much greater extent; that the denticles are broader, not so high, and are not set obliquely on the spine as in *E. vorax*, while the decurrent spur of the enameled base is much longer and more acute.

From the specimen exhibited to the Am. Ass. by Prof. Hitchcock, and which is probably identical with that described in this report, vol. ii, p. 84, as *E. minor*, N., the one before us may be distinguished by its greater size, its more rectilinear outline—having only one of its margins curved—and by its shorter, broader and more erect denticles.

The specimen of *E. vorax* described by Prof. Leidy, is supposed to have been found in the Coal Measures of Western Arkansas, was coated with carbonaceous matter, and was doubtless taken from a stratum of cannel or bituminous shale.

Prof. Hitchcock's specimen was obtained from a layer of "slate" (Bituminous shale ?) which overlies a seam of coal in Parke Co., Indiana.

The specimen described in the 2d vol. of this report was obtained from a bituminous limestone in Posey Co., Indiana; while that before us is reported by Mr. Heinrich to have been found in the coal of Belleville, Illinois.

In all these cases, the enclosing material was undoubtedly an aqueous sediment, as the bituminous shales interstratified with the coal seams and cannel beds always are. There is, therefore, no reason to doubt that the animal which bore this organ was aquatic in habit.*

The species described above is dedicated to Mr. John P. Heinrich, in whose mine it was found, and to whose intelligent appreciation of its scientific value we owe its preservation, as to his courtesy we are indebted for the opportunity of describing it.

---

*In the Am. Jour Sci. 2d series, vol. xxiii, p. 212, will be found a discussion of the origin of the difference between cannel and ordinary bituminons coal. The conclusion drawn from the facts there cited is that this difference is mainly due to the relative quantities of water present during the process of bitumization; cannel coal having been formed from vegetable matter completely submerged, while ordinary bituminous coal was produced from vegetable matter saturated, but not constantly covered with water. In the former case, the vegetable tissue was thoroughly macerated, its softer parts forming a fine carbonaceous pulp which was suspended, transported and deposited in laminated beds by water action. All cannel coals may be said to contain remains of fishes, shells, or aquatic reptiles, while ordinary bituminous coal rarely contains anything but vegetable organisms. In the open lagoons of peat bogs—which receive the leachings of the surrounding mass of vegetable matter, and where a fine carbonaceous mud is deposited with the remains of aquatic animals—cannel may be said to be forming, while the spongy, saturated, but not submerged peat, may be regarded as the representation of our cubical coals.

GENUS CLADODUS.

CLADODUS ISCHYPUS, N. and W.

Pl. iv, fig. 6, 6*a*.

TEETH large and stong; base broad and thick, one and a half inch wide by five-eighths of an inch in its antero-posterior diameter; central cone three-quarters of an inch in hight, broad and thick below, rapidly narrowed to an acute point (in the specimen before us the summit is deflected forward and laterally); anterior face nearly flat, posterior strongly arched, both finely striated, forming an acute angle along their line of junction; lateral denticles numerous, in a single row on the anterior margin, and running up on to the lateral angle of the crown.

The most striking characters of this tooth are its broad thick base—in its longest diameter double the hight of the crown—and the strong, anteriorly flattened and rapidly tapering central cone. These characters, if equally marked in other specimens, will serve to distinguish it at a glance from any other species hitherto described.

Specimen in cabinet of Prof. Litton.

Formation and locality: St. Louis limestone; St. Louis, Mo.

CLADODUS ELEGANS, N. and W.

Pl. iv, fig. 9.

TEETH of medium size, as high as broad, measuring about one inch in each direction; central cone very much compressed, double-edged; anterior face nearly flat, posterior gently arched and regularly striated with nearly equidistant, relatively strong and sharp raised lines, at base about thirty in number, above fewer and stronger; lateral denticles two on either side, of which the exterior pair is much the larger, divergent, flattened before, rounded behind, double-edged, strongly striated.

The general contour of this tooth is remarkably exact and elegant, as is its ornamentation. The central cone is erect, straight and very much flattened.

From *C. spinosus*, which occurs in the same formation, it is distinguished by its relatively narrower base, fewer lateral denticles, and by its flattened ancipital central cone. The same characters will serve to separate it from *C. mortifer* and *C. ferox*, although the former of the last two mentioned approaches it most nearly, and if they occurred in the same deposit it might be suspected that they formed parts of the necessarily somewhat variable dentition of one fish. They are, however, too widely separated geologically, to render this supposition at all probable. The specimen is in the cabinet of Prof. Litton.

Formation and locality: St. Louis limestone; St. Louis, Mo.

CLADODUS DEFLEXUS, N. and W.

Pl. iii, fig. 3, 3*a*.

TOOTH of medium size, base as broad as hight of cone, very narrow; antero-posterior diameter scarcely more than a quarter the breadth; anterior margin straight, posterior regularly arched; central cone flexed laterally and backward, somewhat flattened and strongly striated in front, rounded and finely striated behind; lateral denticles, two on each side, relatively large and nearly equal: sometimes there are one or two additional ones of smaller size.

The laterally deflected median cone, flattened, striated, and angled before, rounded behind, with the very narrow transversely elongated base, will serve as a means of identification of this species wherever found, and to distinguish it from all others of the genus.

Formation and locality: Burlington limestone; Quincy, Illinois.

GENUS PETALODUS.

PETALODUS CURTUS, N. and W.

Pl. iii, fig. 2.

TEETH of moderate size, thin and light in crown and root; crown broadly arched, twice as wide as high, concavo-convex laterally and vertically; superior margin serrated or roughened by the termini of the calcigerous tubes; anterior face of crown without imbricating enamel folds, half as high as posterior face; posterior face elliptical in outline, basal enamel folds 5-6, broad and strong; root relatively short and thin, on posterior face two-thirds the hight of the crown, in breadth two-thirds that of the crown, sides nearly straight, bottom arched and somewhat three-lobed, strongly bevelled off so as to form a blunt edge on the anterior and longer side.

In general aspect this tooth resembles most *P. linguifer*, N. and W., from the Chester limestone, but it is thinner, and has a much shorter root, of which the lower edge is characteristically bevelled. There is no other species for which it is likely to be mistaken.

Formation and locality: Keokuk limestone; Otter creek, Jersey county, Illinois.

GENUS ANTLIODUS.

ANTLIODUS SARCULULUS, N. and W.

Pl. ii, fig. 8, 8*a*, 8*b*.

TOOTH small, oval in outline, thin; root entirely obsolete; upper surface polished and obscurely striated; anterior border raised into a sharp cutting edge, roughened but scarcely serrated by the extremities of the calcigerous tubes; posterior margin bordered by about three imbricating enamel folds, which form a deep bow-shaped arch; anterior face vertical, less than half as high as the antero-posterior diameter of the tooth, terminating in an arched cutting edge above, below by two or three very narrow imbricating folds, surface polished but obliquely punctate; under surface sub-triangular in outline, bony, posterior portion roughened.

This is another of the small unguiform teeth which are so common in the Lower Carboniferons limestone of the Western States, and which form our genus *Antliodus*. On comparing it with the species before described it will be seen that while approaching closely in dimensions and general form to *A. parvulus* (vol. ii, p. 38, Pl. vi, fig. 7, 7*a*, 7*b*) and *A. minutus* (op. cit. p. 43, Pl. iii, figs. 3, 3*a*, 3*b*,) it is specifically distinct. It is a little larger than either; is without the rudimentary roots of *A. parvulus*, less regularly oval in outline, and the anterior margin is more vertical. In *A. minutus* the outline is elliptical, and the imbricated folds more numerous and widely separted.

Formation and locality : Burlington limestone; Burlington, Iowa.

GENUS POLYRHIZODUS.

POLYRHIZODUS TRUNCATUS, N. and W.

Pl. iii, fig. 16, 16*a*.

TEETH small, massive, sub-elliptical in outline; crown gently arched transversely on its upper and anterior face, which is flattened and slightly excavated, and roughened by the oblique sections of the calcigerous tubes; posterior face nearly straight, laterally and vertically smooth or punctate; this is bordered below by four enamel folds which are slightly arched upward at the ends; root very small or obsolete.

Although the specimens which we have of this tooth show little or no root, there is scarce room for doubt that tubercular rootlets existed when it was in a perfect condition; the spongy texture of the root causing it to yield first in the process of decay or abrasion, when the tooth is detached from its support. A comparison with the species we have named *P. inflexus* and *P. porosus* (vol. ii, pp. 48, 49, Pl. ii, figs. 8 and 9) will show that they should be placed in one generic group with that now under consideration.

From those species it is distinguished by its outline, lower and broader than in *P. inflexus*, less low and broad than in *P. porosus*, and by a root more nearly obsolete than in either.

Formation and locality: Burlington limestone; Quincy, Ill.

POLYRHIZODUS LITTONI, N. and W.

Pl. iv, fig. 10, 10*a*.

TEETH of medium or large size, strong, oblong or elliptical in outline, one and a quarter inch broad, half inch high; crown low and depressed, superior margin broadly arched, subacute, roughened by the extremities of the calcigerous tubes; anterior face three lines high, lenticular in outline, with acuminate lateral angles, bordered at base by a narrow, prominent, bow-shaped band of about four closely approximated enamel folds; posterior crown face long-elliptical in outline, five lines high, concave in both directions; root strong but short, two-thirds as broad as the crown; on the posterior face one-third, anterior face two-thirds the entire hight, divided into seven or eight oblong, thick, tooth-like radicles.

This well-marked species has, at first sight, much the aspect of *P. magnus* (McCoy, Brit. Palæoz. Fossils), but is smaller in all its dimensions, much thinner, with fewer and relatively stronger radicles. One of its most characteristic features is the prominent ridge formed by the imbricating enamel folds at the base of the anterior face.

This, with other fish remains, was obtained by Prof. A. Litton, who has kindly loaned it to us for description.

Formation and locality: St. Louis limestone; St. Louis, Mo.

GENUS ORODUS.

ORODUS CORRUGATUS, N. and W.

Pl. iii, fig. 18, 18*a*.

TEETH of various forms and sizes, forming many rows; of these the largest are strongly arched in both directions, the crown of the arch forming a broad, massive eccentric cone, or protuberance, which is without rugæ, but is coarsely granulo-punctate.

The crown surfaces of all these teeth—with the exception of the comparatively smooth cone summits of the largest—are strongly and sharply corrugated by a medial, longitudinal crest, and numerous pinnate lateral crests which run down to and strongly crenulate the sides.

The lateral crests are beaded or pectinated; the whole forming an elaborate system of surface ornamentation.

The smaller teeth vary in size from 10 lines to 4 lines in length, being three times as long as wide, long-elliptical in outline, the larger ones highest near one end, showing a tendency to form the eccentric crown-cones of the larger series.

The beautiful group of teeth represented in our figure form one of the most interesting specimens yet discovered of the dentition of the fishes of the Carboniferous period, and by far the most striking are furnished by the Coal Measure strata. The corrugated and highly ornamented surface of these teeth will serve to distinguish them at a glance from all the teeth of *Orodus* described, therefore no extended comparisons are necessary. It should be said, however, that this group of eleven teeth, though evidently belonging to one individual, give but an imperfect idea of his complete dentition. They are not in their normal position, for the longer diameter of all doubtless once coincided with the arch of the jaw on which they were placed. If this is true – and the analogies presented by the dentition of living and fossil cestracionts all indicate that it is so—we must suppose that the smaller teeth have been shifted from their original position, in which they must have presented their ends rather than their sides to the series of larger teeth. In *Acrodus*, the Jurassic representative of *Orodus*, as in the living *Cestracion*, we find the largest and strongest teeth placed near the middle of each mandible at the point where the muscles which raise it act with the greatest mechanical advantage: the symphysis of the jaw being generally covered by more or less conical and what may be called prehensile teeth; while the posterior portion of each ramus bears rows of teeth diminishing in size backward. A similar structure is visible in the dentition of the mammalia, where the anterior portion of the jaw is occupied by incisors and canine teeth, the middle portion by the molars, or grinders as they are properly denominated. Reasoning from these analogies, we should consider the group of teeth under consideration as having occupied the middle and posterior portion of the left mandible or the right maxillary.

What were the forms of the anterior teeth of the series to which these belonged we can only conjecture, but the very striking resemblance which the teeth we have described under the name of *Lophodus variabilis* (Pl. iv, fig. 4,4*a*, 4*b*, 5, 5*a*, 11, 11*a*, 11*b*, present to these, in the surface markings of all, and the form of a part, suggest that the two groups once formed but portions of the dentition of one genus; the conical forms of *Lophodus* being the anterior teeth.

Formation and locality: Coal Measures; Alton, Ill.

GENUS HELODUS.

HELODUS RUGOSUS, N. and W.

Pl. ii, fig 10, 10*a*.

TEETH small but strong; crown broadly conical in outline, set obliquely on the root, lateral extremities rounded, entire surface roughened by papillæ of enamel, or vermicular raised lines; root as high as the crown and nearly as wide above, rapidly narrowed downward where it becomes thinner, and terminates in a sharpish edge; posterior face of root shorter than anterior, and marked by strong, vertical ridges and furrows.

In general form the teeth of this species resemble those of *H. compressus*, but are smaller and less flattened. The character by which it may be distinguished from all other known species of the genus is the rugosity of the crown surface.

Formation and locality: Coal Measures; Collinsville, Illinois.

HELODUS COMPRESSUS, N. and W.

Pl. iii, fig. 15, 15*a*.

TOOTH small, much compressed or flattened; crown yoke-shaped, smooth, coarsely punctate, bearing a flattened, smooth, sub-central, medial cone, arched upward at base; root less in hight than crown, bevelled to an edge below, and marked on either surface with vermicular lines.

In outline this species resembles *H. consolidatus*, N. andW. (vol. ii, p. 87,Pl. vi, fig. 2) but is much smaller and more flattened.

Formation and locality: Burlington limestone; Quincy, Illinois.

GENUS LOPHODUS, N. and W.

TEETH of various forms, many transversely elongated; the crown raised into several summits, and traversed in its longest diameter by a sharp crest; root vertical, flattened. In others the medial cone is greatly developed, the lateral ones obsolete or represented by buttress-like wings that are given off on one side of the tooth. The medial cone is laterally compressed, and bears a sharp crest along its antero-posterior medial line.

The most elongated of these teeth, taken by themselves, would be included in the genus *Orodus*, being formed altogether on the same plan; but those bearing the high, ancipital, medial cone are very different from any found in the dental series of *Orodus*, and approach the form of the ancipital teeth of some of the mesozoic reptiles.

There is no doubt of the affinity of the fish that bore these teeth with *Orodus*, but the differences which have been indicated seems to us of generic value.

Orodus has, up to the present time, not been found in strata more recent than the Lower Carb. limestone, and we may regard *Lophodus* as the representative of that genus in the fauna of the Coal Measures.

LOPHODUS VARIABILIS, N. and W.

Pl. iv, figs. 4, 4*a*, 4*b*, 5, 5*a*, 11, 11*a*, 11*b*.

TEETH of medium size, of three or more forms; largest and central? teeth (fig. 11) having a V shaped base, on the angle of which is set an ovoid or conical, laterally compressed crown which bears on the medial line a sharp, serrated crest, passing from the base on the anterior face over the crown to the base on the posterior face. On the anterior side the crown is constricted at its juncture with the base. On the posterior face it is supported by acute crested buttress-like wings, which run down to the lateral prolongations of the base. The base is vertically flattened under the wings of the crown, thicker and conical before, somewhat pitted and roughened. Other teeth of the series are transversely elongated laterally, somewhat arched backward at the extremities. The crown has a general conical outline with a pectinated crest along the most elevated line. Transverse crests cross the central summit and two lateral eminences from front to rear. On the posterior face the central and lateral eminences form strong ridges which give the tooth a peculiar yoke-like plan.

The third form of tooth (fig. 5) is still more elongated laterally, having the form of some species of *Orodus*. The crown is marked by a central or subcentral prominence, on either side of which are several minor summits which may be said to be formed by projecting rings arching over the crown from front to rear. The root is vertical, flattened, pitted or vermicularly marked, and bevelled on the lower edge. Like the others, these teeth are ornamented by pectinated ridges along the line of greatest elevation, and transversely on the more prominent points.

The enamelled surface of the crown in all these teeth is highly polished, and must have been very hard. Though obscurely granular throughout, it can hardly be said to be anywhere punctate.

Formation and locality: Coal Measures; La Salle, Ill.

GENUS PELTODUS, N. and W.

TEETH small and low, round, oval or elliptical in outline, arched above in both directions, concave or flattened below; crown surface most strongly arched from front to rear, highest near the anterior margin, more or less evenly punctate throughout; under surface bony and rough; margins thin and irregular where the teeth are separated, thickened and even along the lines of contact when closely set.

These teeth indicate a dentition intermediate in character between that of *Psammodus* and *Cochliodus;* less flat, smooth and pavement-like than the former; less convoluted than the latter; though, doubtless, performing the same duty—crushing the shells of mollusks—for which the teeth of so many of the Cestracionts were employed. They are smaller and thinner than the teeth of the genera which have been cited, *Sandalodus*, *Deltodus*, etc., and apparently belonged to the humbler members of the great group of Selachians which inhabited the Palæozoic sea. The type species, *P. unguiformis*, is found in the calcareous beds of the Coal Measures, and forms a distinct and interesting element in the small Cestraciont fauna of that epoch; the few and feeble representatives of the shoals of sea monsters which lived in the epoch that immediately preceded.

Among the fish teeth from the Lower Carb. strata contained in the collection there are some which so much resemble these in general character, that they have been placed in the same generic group under the name of *P. pulvinulus.* They are longer, thicker, more elongated laterally, and much more coarsely punctate.

In *P. unguifcrmis*, the broader, anterior end bears marks of attrition, and it is evident that they were so placed on the jaw that the anterior margin was most elevated and took all the wear to which the tooth was subjected. From this it will be seen that, though resembling some of the Petalodont teeth in general form, they were placed on the jaw in reversed position from them, as though the teeth of *Antliodus* were turned with the concavity down. The distinction of crown and root, and the imbricated enameled folds visible in all the Petalodonts are in *Peltodus* entirely wanting.

PELTODUS UNGUIFORMIS, N. and W.

Pl. ii, fig. 7, 7a.

TEETH small, ovoid in outline, thin, convex above, concave below; antero-posterior diameter of largest individuals half inch; lateral diameter quarter inch; anterior margin broadly rounded, posterior portion narrowed to the abruptly rounded or truncated edge; crown surface obscurely punctate over the middle and posterior parts, distinctly so on anterior slope which formed the triturating surface.

There are several of these little teeth in the collection, all from the upper Coal Measures, and all alike in the generalities of form and structure, though varying considerably in size. They are quite thin and are the smallest and most delicate of all the great series of crushing teeth which have been obtained from the Carboniferous strata of Illinois. In general aspect they are not unlike a small, much-curved nail of the human hand; a resemblance which has suggested the name given to the species.

Formation and locality: Upper Coal Measures; La Salle, Ill.

GENUS CYMATODUS, N. and W.

TEETH of medium or small size, oblong or elliptical in outline, thin, forming a flat or arched plate of which the crown surface is transversely undulated and uniformly punctate; under surface flat and smooth, at the posterior end bearing a narrow, strap-shaped, oblique root.

This genus is created to receive a quite perfect and peculiar tooth from the Coal Measures, of which a more detailed description is given below. This tooth has much in common with *Deltodus* and *Pœcilodus*, and was doubtless used for precisely the same purposes in the same manner. It has, however, no definite deltoid form, and no ridges or furrows which follow the line of curvature, as in *Deltodus*, nor yet the banded structure of crown surface which is the most prominent character of *Pœcilodus;* and more than in all things else it differs from the teeth of the genera cited, by its long, narrow, back-reaching root.

No teeth bearing any close resemblance to this have been found in the Lower Carb. limestone, and it probably represents a genus of Plagiostomous fishes which inhabited exclusively the Coal Measure seas. It would seem that in the region east of the Mississippi, during the Coal Measure epoch, marine conditions prevailed only locally and for a limited period; circumstances apparently not favorable to the existence of any considerable number of large cartilaginous fishes; for we here find a marked falling off from the rich and diversified ichthyic fauna of the Lower Carboniferous period.

CYMATODUS OBLONGUS, N. and W.

Pl. iv, fig. 7, 7*a*.

TEETH of medium or small size (one inch long by three-eighths of an inch wide), oblong or spatulate in outline, thin, flattened and somewhat arched; crown surface undulated by relatively large, transverse waves, in all parts and nearly equally dotted by the round or vermicular sections of the oblique calcigerous tubes; under surface parallel to the crown face, smooth throughout the broader portion of the tooth, near the narrow end rising into a long, narrow, strap-shaped, curved root.

The generalities of the form and structure of this tooth are given in the generic description which is based upon it. It will be seen to have considerable resemblance to the undulated species of *Deltodus*, but the transverse waves of the crown surface are more acute-crested, are not curved as in those species, and no species of *Deltodus* has the root which forms so conspicuous a feature in this tooth.

Formation and locality: Upper Coal Measures; LaSalle, Illinois.

GENUS COCHLIODUS, Ag.

COCHLIODUS COSTATUS, N. and W.

Pl. iii, fig. 10, 12, 12*a*.

TEETH relatively small, very convolute, crown surface bearing strongly marked ridges in the line of enrollment; enamelled surface uniformly punctate throughout, sometimes with obscure transverse lines of growth; anterior convolute tooth very small, form unknown, second tooth spirally enrolled, narrow, obliquely triangular in outline, posterior margin rounded, lateral margins sulcated for co-adaptation, crown bearing a single central revolving ridge; third tooth much broader, also strongly revolute, bearing a distinct ridge on its anterior border and another much stronger on the median line; a deep and smooth sulcus separates the ridges.

These teeth form a typical species of *Cochliodus* corresponding accurately in position, relations, and general form with those of *C. contortus*, Ag., on which the genus was founded.

Deltodus had apparently a similar series of teeth on the mandibles, but they were less convolute. There are, however, connecting links between these genera which render it very difficult to separate them.

In our description of *Cochliodus nobilis* (vol ii, p. 89) we noticed the discovery of a mass of teeth, evidently the dentition of one individual, which includes forms that have been referred by Agassiz to *Cochliodus*, *Helodus*, and *Streblodus*. We then suggested that the teeth having the *Helodus* form were placed in the middle and anterior portion of the jaws, corresponding to the middle series of conical teeth in *Cestracion*.

Prof. Owen has recently figured mandibles of *Cochliodus* and other Cestracionts in which no space is left between the convolute teeth for any such group as those of *Cestracion* referred to. It should be stated, however, that the dentition of the upper jaw of these fossil Cestracionts has never been seen in place, and the mandibles of *Cochliodus* have never been found absolutely terminated anteriorly. In *Cestracion* they approach each other so closely posterior to the group of conical teeth, that if the extremity were removed by decay or violence, the jaw would seem to be normally terminated without any cuspidate teeth.

Hence, we may say that the presence of conical teeth in the dentition of any of the fossil conchivorous sharks is not yet disproved.*

Formation and locality: Burlington limestone; Burlington, Iowa.

---

*The figure given as that of the head of " *Cestracion*, Philipi" in Owen's Palæontology, 2d edition, p. 126, is really a representation of the head of *Myliobates Aquila* turned wrong side up.

GENUS PŒCILODUS, Ag.

Pœcilodus convolutus, N. and W.

Pl. ii, fig. 9.

Teeth small and thin, spirally enrolled, arched transversely by a strong, obtuse ridge, which occupies the central portion in the line of spiral curvature. On each side of this ridge is a shallow furrow, which, on one side, is bordered by the raised margin of the tooth; entire triturating surface marked by numerous nearly equi-distant ridges or folds, obliquely transverse to the line of enrollment. These rugæ are obtuse and, like the inter-spaces, coarsely punctate.

The analogue of this species is *P. angustus*, Ag., found in the Carb. limestone of Armagh, Ireland. That species is, however, generally smaller and narrower; the plications of the enameled surface do not cross the medial ridge—affecting only the sulci—and they form a ruffled margin to it on either side. In our species they affect equally the ridge and the lateral furrows.

From the other species found in the Carboniferous strata of Illinois (*P. rugosus* and *P. ornatus*,) it is distinguished by its smaller size, more convolute form and smoother surface.

Formation and locality: Keokuk limestone; Warsaw, Illinois.

GENUS DELTODUS, N. and W.

Deltodus fasciatus, N. and W.

Pl. iii, fig. 17.

Teeth large and strong, sub-spatulate in outline, very obliquely convolute, without longitudinal ridges or furrows; crown surface marked by transverse alternate bands of denser and more porous tissue, which, on the upper portion, are suddenly bent upward as they approach one side; below are imperfectly parallel with the rounded margin of the broader end. These bands give a peculiar waved appearance to all the upper surface.

This tooth illustrates the difficulty of establishing a satisfactory classification among Plagiostomous fishes by a comparison of one set of organs alone; for, with the general form and structure of *Deltodus*, it has the crown surface covered with alternate bands of dense and porous tissue, scarcely different from those which have been relied upon as the distinctive character of the genus *Pœcilodus*. In *Deltodus undulatus* (vol. 2, p. 98), the crown surface is waved on its lower half, though there is little difference in the porosity of the ridges and furrows, and the triangular, deltoid outline is distinctly marked. In *D. cingulatus* (vol. 2, p. 99), the bands of dense and porous tissue are much more strongly defined, and that tooth would perhaps naturally fall into Mc'Coy's genus *Climakodus* (or, as he writes it, Climaxodus), taking the name of *C. cingulatus*. It is of very little consequence in which of these two none-too-well defined generic groups, *Deltodus* or *Pœcilodus*, this is placed, but it is of consequence that this so strongly marked and conspicuous fossil of the Keokuk limestone should be made known, that it may be used for geological purposes.

Formation and locality: Keokuk limestone; Warsaw, Illinois.

DELTODUS LITTONI, N. and W.

Pl. iv, fig. 8. 8*a*.

TEETH of medium size, one inch and three-quarters long by one inch wide at broader end, very thick and strong, triangular in outline, strongly convolute, narrow end terminating in an acute angle, opposite and broader end regularly arched; crown surface mainly occupied by a very strong but obtuse ridge which follows the line of curvature along one of the margins. This ridge is bordered by a broad, shallow furrow which reaches to the oblique lateral border, and which is slightly raised; entire enamelled surface coarsely granulo-punctate, but otherwise smooth.

In form and size this tooth approaches that of *D. stellatus*, N. and W. (vol. 2, p. 97), but is more convolute in form, thicker, the crown surface smoother, the ridge less angular, the punctation simpler. There is no other species for which it is likely to be mistaken.

Dedicated to Prof. A. Litton, of St. Louis, Mo.

Formation and locality: Lower Carboniferous limestone; Boone county, Mo.

DELTODUS ANGUSTUS, N. and W.

Pl. iii, fig. 7.

TOOTH narrowly triangular in outline, about one inch in extreme length by one-quarter inch in breadth at widest part; under surface nearly flat; upper face coarsely punctate and raised by a strong but obtuse ridge which borders the longer margin, running from the narrower nearly to the broader end, where it gradually slopes down to the edge. Parallel with the margin of the tooth, opposite the ridge, is a broad, shallow furrow, which runs from the narrower to the broader end.

This tooth is much smaller and relatively narrower than any other species of the genus hitherto described. In its general aspect it is most like *D. rhomboideus*, N. and W. (Geol. Survey Illinois, vol. 2, p. 100, pl. ix, fig. 8), but is very much narrower and has but a single ridge, while *D. rhomboideus* may be said to have three ridges crossing the crown longitudinally.

Formation and locality: Chester group; Chester, Illinois.

DELTODUS ALATUS, N. and W.

Pl. ii, fig. 6.

TEETH of medium or large size, thick and massive, broadly triangular in outline, strongly arched in both directions, crown mainly composed of one high and broad arched ridge extending from the acute angle to the opposite side, bordered on the shorter side of the triangle by a relatively broad, low margin or wing; bony base of the tooth prolonged, in a wing-like expansion from the broad, rounded extremity of the crown ridge; enamel surface all coarsely granulo-punctate.

This species has much in common with *D. spatulatus* (vol. 2, p. 100, pl. 14, fig. 7), but the wing-like expansions of the crown and base, referred to in the description given, have not been noticed in any specimens yet found of that species, which also comes from a different horizon, the Burlington limestone, where nearly all the species are distinct from those accompanying the fossil under consideration. A beach-worn tooth, from which the margin had been removed, leaving only the spatulate ridge of the crown, would hardly be separable from those of *D. spatulatus*, but as we have teeth of both in nearly perfect condition, we are compelled to regard them as representatives of allied but really distinct species.

Formation and locality: Keokuk limestone; Warsaw, Illinois.

GENUS SANDALODUS, N. and W.

SANDALODUS CRASSUS, N. and W.

Pl. iv, fig. 3, 3a.

TEETH clavate in form, very thick and strong, two inches long, five-eighths inch broad where widest, three-eighths inch thick; one margin nearly straight, the other forming a broad arch; crown surface irregularly spatulate in outline, strongly arched in the line of the shorter diameter, toward the narrow end showing a broad but well marked longitudinal furrow; enamel coating uniformly, rather finely punctate.

The tooth, of which figures are now given, though from the Lower Carboniferous limestone, is remarkably like those of *S. carbonarius*, described in vol. 2, p. 104, though by its greater relative thickness, more arched section, etc., specifically distinct. It will be seen that the teeth of these two species present some common characters—in their one straight and one arched margins, their broadly rounded anterior end—not possessed by the typical species of *Sandalodus*, so that when a larger number of specimens shall be obtained it may be found convenient to divide them into two generic groups. For the present, however, in consideration of the marked similarity which they all exhibit in their surface markings, general spatulate form, longitudinally plane, laterally concave base, it has been thought best to group them together.

We owe this specimen to the courtesy of Prof. Litton, of St. Louis.

Formation and locality: St. Louis limestone; St. Louis, Mo.

GENUS PETRODUS? McCoy.

PETRODUS (?) PUSTULOSUS, N. and W.

Pl. ii, fig. 5, 5a; pl. iii, fig. 6.

DERMAL tubercles (?) of large size, very thick and massive, ovoid or sub-triangular in outline, flattened below, arched or conical above; under surface flat, or slightly concave, rough; upper surface smooth, at summit somewhat ridged with short rows of enamelled tubercles; microscopic structure showing a congeries of irregular, vertical, prismatic columns.

Of these specimens the larger one, represented by fig. 5, 5*a*, plate ii, is evidently much worn on the upper surface, and is so massive and strong that it seems something of a stretch of the imagination to consider it a dermal tubercle. It has, however, a strong generic resemblance to the specimens of *Petrodus occidentalis*, figured in vol. 2, pl. iv, especially to that represented in fig. 16, and is also so closely allied to the smaller specimen now figured (pl. iii, fig. 6), that there seem to be no good grounds for separating them.

As has been stated in our description of *P. occidentalis* (l. c.), there are apparently good reasons for considering that to be the dermal tubercle of some Plagistomous fish, and the reasons given for that conclusion are to a certain degree applicable to the specimen before us. The microscopic structure is certainly different from that of any of the *teeth* which have come under our notice. The mass of this fossil is composed of contiguous, prismatic columns, which run through from the upper to the lower surface; in the larger specimens apparently solid and homogeneous in structure, while in the smaller they form polygonal tubes which give a reticulated marking to the upper surface. These prisms may be considered to be the homologues of the calcigerous tubes which by their ends mark the enamelled surface of most of the placoid teeth that have been described, but in all the species of *Psammodus*, *Deltodus*, etc., these tubes are distinctly separated at their superior extremities, while they inosculate below. The difference which the two forms of structure exhibit will be best understood if we compare the calcigerous tubes of *Psammodus*, *Cochliodus*, etc., with *Syringopora*, while the tubes or prisms of the specimens before us may be compared to *Favosites*.

Formation and locality: Burlington limestone; Burlington, Iowa.

GENUS ASTEROPTYCHIUS, Ag.

ASTEROPTYCHIUS TRIANGULARIS, N. and W.

Pl. ii, fig. 4.

SPINE short, robust, with a nearly equal-sided, triangular section, the sides concave; anterior keel strong, sharp, and smooth; lateral surfaces marked with 5-6 nearly equal, smooth, flattened, enamelled carinæ, separated by sulci which are longitudinally striated. These sulci are very unequal in width, the anterior one being much the broadest, occupying nearly half the lateral surface, and set with enamelled tubercles, forming a single row above, below irregularly scattered. The posterior denticles are not distinctly shown in the only specimen obtained.

This species is clearly generically identical with those described by Agassiz and McCoy (British Palæoz. fossils, pp. 615, 616, pl. 3K, figs. 22, 23, 24), and forms an interesting addition to the genera common to the Lower Carboniferous strata of the old and new worlds. From the two species to which reference has been made, this is, however, distinguishable. From *A. ornatus*, Ag., it is separated by its single longitudinal band of tubercles, and its larger number of lateral carinæ. From *A. semi ornatus*, McCoy, it differs in its triangular section being much less compressed laterally, and in the greater inequality in the breadth of the sulci.

Formation and locality: Burlington limestone; Quincy, Illinois.

GENUS LISTRACANTHUS, N. and W.

SPINES small, gently arched, flattened, thin; sides marked by numerous sharp longitudinal carinæ, edges set with many divergent slender acute teeth, those on the convex margin most numerous and largest; base abruptly expanded, and obliquely truncated.

These spines are considerably unlike any hitherto described. They are marked on the sides somewhat like *Leptacanthus*, but are flatter, shorter, and more rapidly narrowed above, while the bristling, divergent teeth of both margins serve to distinguish them at a glance. The base is different from that of most defensive spines, as it is abruptly truncated and expanded: showing that it was set on the surface and did not penetrate the integuments.

In this respect these spines resemble those of *Climatius*, as well as those of some recent scaled fishes (*Gasterosteous*, etc.), and may be considered modified scales or cranial scutes. They were probably attached by their broad bases to the body or head, serving perhaps both for ornament and defense.

LISTRACANTHUS HYSTRIX, N. and W.

Pl. ii, fig. 3, 3*a*.

SPINES small, delicate, thin, flattened, broad below, rapidly narrowed above, gently arched in outline, both edges set with sharp, spiny teeth directed upward; the sides marked with fine longitudinal ridges, which successively terminate above in the margin.

Two specimens of this distinctly new form are before us, of which one is three inches, the other, one inch in length. In the larger specimen, the marginal teeth are very numerous, of unequal size—those of the concave margin being much the larger. In the smaller specimen they are fewer, relatively larger, and about equal on both margins. The base is the same in each, obliquely truncated, and expanded like a trumpet mouth, indicating that it was set on the surface of body or head, and had not been inserted in the integuments.

Formation and locality: Coal Measures; Vermilion county, Ill.

GENUS CTENACANTHUS, Ag.

CTENACANTHUS MAYI, N. and W.

Pl. ii, fig. 2, 2*a*.

SPINE of medium size, six to eight inches long by one and a-quarter broad at base, much compressed, gently arched backward; summit sub-acute, smooth; anterior and convex margin sub-acute and marked by relatively large and remote annular tubercles; posterior margin furrowed longitudinally and striated transversely, the salient edges set above with remote and small denticles; sides flattened, and ornamented by ten or more strong longitudinal costæ bearing flattened annular tubercles.

This is a typical species of the genus, and perhaps the most beautiful yet discovered. Its outlines are regular and elegant; the ornamentations very elaborate and distinct. It may be readily distinguished from all other known species by its great relative breadth, its flattened, compressed sides, and strong, crowded ornamentation. The number of the longitudinal ribs is not the same on the two sides, and they increase toward the base, as is usual in the genus, by their bifurcation. They cover the entire surface of the exposed portion, except just at the summit, which is smooth, and evidently worn by use.

Formation and locality : Lower Carb. limestone; Burlington, Iowa

GENUS PHYSONEMUS, Ag.

PHYSONEMUS GIGAS, N. and W.

Pl. ii, fig. 1.

SPINE large, massive and strong, one foot or more in length, two inches in breadth, and three-fourths of an inch in thickness at the base; strongly curved, with the summit turned toward the front; base expanded, flattened, and somewhat bilobed; posterior (convex) margin slightly flattened, and obscurely furrowed longitudinally; anterior (concave) margin sub-acute, beveled, the flattened faces which include the angle covered with a fine reticulated ornamentation, and bearing each a single row of remote, large obliquely-stellate, enamelled tubercles, which alternate with those of the other side.

Only the basal portion of one of these spines has, at yet, come under our observation. This is, however, sufficient to prove it quite different from any other hitherto described from an American locality. Its rarity, great size, peculiar markings and reversed curve, all combine to make it a specimen of unusual interest, but it has a still higher value in its close generic identity and specific affinity with a spine obtained by Prof. McCoy from the Carboniferous limestone of Armagh, Ireland, and described by him (*Brit. Paleoz. Fossils, p.* 638, *Pl.* 3 *I, fig.* 29) under the name of *Physonemus arcuatus.*

The resemblance between the spine described and figured by McCoy, and that before us, is so strong that we have had some hesitation in deciding them to be distinct. Our spine is, however, many times larger than that which occurs in the Armagh limestone, and the large stellate tubercles of the anterior margin are very obliquely conical, the summit being turned toward the base of the spine, so that if a little prolonged they would form hooks. In *Ph. arcuatus* they are represented as being symmetrical. No generic or specific description was ever given by Agassiz of the spine which he named *Ph. subteres*, so that it is not certain that it should be considered generically identical with the one now under consideration, but there can be no question that our spine belongs to the same genus with McCoy's *Ph. arcuatus*, and as he has framed a generic description on that, our species may be almost considered a type. The great size of our specimen, however, requires a qualification of so much of McCoy's description as refers to the size ("Fin spine of small or moderate size").

Formation and locality: Burlington limestone; Quincy, Ill.

Note on the Genus *Rinodus*, N. and W.

When the descriptions of the fish remains described in Vol. II, were written, we had not access to all of Pander's Monographs of the Fossil Fishes of Russia. Since then we have obtained them, and find in his paper (*Uber die Ctenodipterinen des Devonischens Systems*, pp. 48–51, Pl. viii and ix,) descriptions and copious illustrations of a group of fish teeth from the Devonian rocks of Russia, which include two species unmistakably generically identical with that peculiar one described by us (Vol II, p. 106, Pl. x, figs. 10, 10a, 10b), under the name of *Rinodus calceolus*. These are grouped by Pander in the genus *Ptyctodus*, forming his two species, *Pt. obliquas* and *Pt. ancinnatus*. Both these species are ornamented on the sides, where ours is plain, and hence are apparently specifically distinct; but, in the generality of form and structure, the resemblance is so close that no one would hesitate to include them all in one genus. Our species, *Rinodus calceolus*, must therefore, take the name of *Ptyctodus calceolus*.

So far as we can learn, no teeth of this kind have been found elsewhere in Europe than in Russia, and there only in the Devonian strata. It is, therefore, a fact of peculiar geological interest that a very closely allied species should reappear in far distant America, in the same geological horizon.

PART II.

PALÆONTOLOGY OF ILLINOIS.

SECTION II.

REPORT ON THE FOSSIL PLANTS OF ILLINOIS.

By LEO LESQUEREUX.

FOSSIL PLANTS.

INTRODUCTORY REMARKS.

The generic classification of the species of fossil plants, enumerated and described in this paper, is the same as that in the second volume of this Report. Perhaps it would have been advisable to modify, by subdivision, a number of our genera, especially for some species of ferns, of which we have recently obtained fruiting specimens, which seem to indicate a relation to peculiar species of the present time. But as this Report is a mere continuation of the first, a change of classification would have rendered it more obscure to the student, and would have required a long discussion on the value of some of these new genera, without any advantage to science. For the fructifications of the fossil ferns are scarcely, if ever seen, except obscurely, through the substance of the leaflets under which they are attached, and even when the position of the *sori* or groups of fructifications relatively to the veins and veinlets, or to the borders of the leaflets can be ascertained, their true form, and especially the mode of attachment and of dehiscence of their *indusium* cannot be recognized. The natural affinity of these fruiting fossil fragments is, therefore, always more or less uncertain, and a mere change of name, without sufficient authority, tends to obscure, rather than to enlighten the classification. I have, therefore, merely appended some remarks to all the species, which, by their known organized parts, may differ in some way from the characters of the genera to which they are united. I have also, in this paper, omitted to repeat descriptions of genera and of species already given in the second volume of the Report, but have added to the names such remarks as have been suggested by the discovery of more complete specimens. In botanical palæontology, we have to deal merely with fragments, and none of these separate fragments are sufficient, in themselves, to indicate the general character of the whole plant to which they belong. The discovery of each part of a fossil plant adds, therefore, to our acquaintance with a species, and the record and description of any of the separate members, are often of more value to botanical science, than the description of so-called new species, established on some remains of a peculiar form, and of unknown relation.

The number and diversity of the plants published in this volume, tend to indicate the richness of the fossil flora of our Coal Measures, and at the same time, show an increasing activity in research.

The publication of the fossil flora of the second volume of the Geological Survey of Illinois, has excited a remarkable interest for botanical palæontology. Not only private gentlemen have given their time to the collection of specimens, but local societies have been formed for encouraging research, and founding cabinets of fossil plants. We can therefore hope soon to see our fossil flora in America as thoroughly studied and as well known as that of Europe, where this field of science has been ardently worked for more than a century.

Among those to whom the survey is especially indebted for the communication of valuable material used in the preparation of this Report, thanks are due to Mr. Jos. Even, of Morris, who, after the loss of his valuable cabinet by fire, has begun again his researches with renewed zeal and great success; and to Mr. S. S. Strong, of the same place, who has most liberally presented the State Cabinet and myself with a large number of specimens of rare and new species. Messrs. M. Prendel and John Collins, also of Morris; Mr. M. S. Hall, formerly of Wilmington, and Mr. Thos. Tijou, of Duquoin, have also furnished valuable contributions to this Report. As, moreover, the assistants of the State Geological Survey were instructed by the State Geologist carefully to look for and preserve specimens in their explorations, and as the Director of the Survey and myself worked hard in collecting specimens as often as opportunity permitted, the amount of materials which have been examined for this report, and which now mostly belong to the State Cabinet in Springfield, are extensive and of great value.

DESCRIPTION OF NEW SPECIES, AND AN ENUMERATION, WITH REMARKS, ON SPECIES ALREADY KNOWN.

FUCOIDES, OR MARINE PLANTS.

GENUS CHONDRITES. Sternb., Vers. 2, p. 25.

FROND cartilaginous; stem filiform, dichotomous; branches cylindrical.

CHONDRITES COLLETTI, Sp. nov.

FROND large, dividing fan-like into numerous crowded branches, dichotomous, either diverging on both sides of the main axis or arched on one side; ultimate divisions simple, linear, cylindrical, with irregular borders.

This species is not as yet satisfactorily known. I have but recently received from Mr. John Collett, Eugene, Ind., some specimens of a black, fossiiiferous limestone, whose surface is marked with the remains of these plants, true Fucoides. The species distantly resembles, by the curving of its branches, *Fucoides cauda galli*, Van. But it is evidently a compound of separate branches, dichotomous from near the base of the frond (the base is broken from the specimen), the branches in dividing and ascending, forming fan-like or flabellate fronds. The branches, which are ultimately simple, leave upon the stone a half cylindrical impression, and are distinct from each other. The locality is indicated as Towle's mill, five miles east of Lodi, Ind., and the geological position about the level of coal No. 1 of the Ill. section. If it is so, this black fossiliferous limestone, whose characters are so much like those of the Penna. black limestone seen at the top of the millstone grit with *Caulerpites marginatus*, Lesqx., Jour. Am. Phil. Soc., vol. 13, p. 313, occupies the same level. This is a peculiar coincidence of a singular formation, which, exceptionally in the flora of the Coal Measures contains Fucoides, in both the coal basins of Penna. and of Illinois.

FRONDS AND BRANCHES OF FERNS.

GENUS NEUROPTERIS, Brgt.

This genus, limited as it is, vol. ii, p. 427 of this Report contains some species, whose leaflets, more generally round, have no distinct medial nerve, and which, from this peculiarity of form and nervation, are referable to the genus *Nephropteris*, Brgt., already a modification or subdivision of the genus *Cyclopteris*, of the same author. As some of our species are represented, even on the same specimens, by fronds bearing both oblong leaflets with a well marked medial nerve, and nearly round ones without it; or by branches bearing round or polyform pinnules with a definite medial nerve, and oblong ones without a trace of it, the subdivision of the genus *Neuropteris* is as difficult as it is inconvenient, with the materials now at hand. This opinion is further supported by the descriptions and figures of some of our species.

NEUROPTERIS HIRSUTA, Lesqx.

Boston Jour. of Nat. Hist., 1854; State Geol. Rept. of Penna., p. 857, Pl. iii, 6*f*, Pl. iv, fig. 1 to 16, excl. syn.

The degree of relation of this species with *Neuropteris cordata*, Brgt., is not yet ascertained. In his admirable work on the Fossil Flora of the Permian (1864–65) p. 100, Pl. xi, fig. 1 and 2, Prof. Goppert has published as *Neuropteris cordata*, Brgt., part of a pinna, bearing on one side of its broad rachis a series of alternate, oblong, cordate, obtuse leaflets, one inch broad, four inches long, marked with a thick medial nerve, and on the other side diminutive leaflets, very short and enlarged, resembling, according to the author's remarks, some of those of the polymorphous *Neuropteris auriculata*, Brgt. If the true *Neuropteris cordata* has such leaflets of various forms alternately attached to a common rachis, as Goppert describes, our *Neuropteris hirsuta* is certainly not identical with it. For this very common and polymorphous species of ours, whose frond is sometimes 5 feet long, and at least tripinnate, and generally bears compound tertiary alternate pinnæ or pinnules formed of a large oblong or lanceolate obtuse leaflet, cordiform at base, having on each side, and attached to the base of its slightly elongated pedicel, a small round or veniform pinnule, which is as different in its form as in its nervation from the main middle leaflet. This one has generally a well marked, sometimes thick medial nerve, from which the veins go out, anastomosing and curving to the borders; while the veins of the small basilar leaflets all come out of an enlarged or circular base, without trace of a medial nerve. These leaflets are, therefore, true *Nephropteris*, while the main pinnule is a *Neuropteris*. We have obtained from various parts of our Coal Measures, where this species is the most abundant of all, numerous specimens which all show the same characters. The pinnæ decrease in size to the point, and the two upper leaflets under the terminal pinnule are simple or do not bear at the base the small round pinnules; all the others are compound. This terminal pinnule is large, round oval, obtuse and entire. On the other side, Prof. F. A. Rœmer has published in the Paleontographia (1860) p. 186, Pl. 29, fig. 4, a leaf which he considers identical with *Neuropteris cordata*, Brgt., though he calls it *Dictyopteris cordata*. It resembles one large leaflet of *Neuropteris hirsuta* by its form, and by the straight pointed hairs with which its surface is marked. But in the leaf figured by the German author, the veins and veinlets are undulate, and in curving and anastomosing, they pass from one to the other, forming a kind of reticulation, like that which characterizes the genus *Dictyopteris*. As this peculiar mode of reticulation is not remarked in our species, we have to consider it as different from *Neuropteris cordata*, Brgt.

NEUROPTERIS FASCICULATA, Sp. nov.

Pl. v, fig. 1 to 4.

FROND pinnately divided, bearing alternate ovate lanceolate pointed leaflets, variable in size, irregularly rounded or auriculate at the base, being more extended on one side than on the other, or truncate on one side, and rounded on the other. Medial nerve distinct, and comparatively broad, either descending to the point of the leaflets, or disappearing at or below the middle, sometimes absent; veinlets thin, close to each other, scarcely distinct, arched, forking in ascending.

This species, by the divisions of the leaves, presents a truly peculiar appearance, which does not compare with any previously known fossil plants, except perhaps with some of the abnormal forms of *Neuropteris hirsuta.* It is evidently distinct from this last species, as shown by its smooth (not hairy) surface, its thinner texture, its more closely approached veinlets; by the pointed form and the peculiar division of the leaflets, which are generally united three together, and by a subdivision of the main rachis. In the specimen represented by fig. 3, the large leaflet has a well marked medial nerve, while the small ones have no trace of it. The specimen represented by fig. 4 is creased in the middle, but the secondary nerves come out from the broad, round base, as in the genus *Cyclopteris.* I consider it as one of the leaflets attached to a round, perhaps climbing stem, while the others represent the top leaves I have only seen of this species the four specimens figured here. Figs. 2 and 3 are from the bottom clay of the upper coal bed of Neelyville, Morgan Co.; the two others in concretions from Mazon creek, Grundy Co.

NEUROPTERIS COLLINSII, Sp. nov.

Pl. v, fig. 5 and 6.

THE mode of division of this species is still unknown, as it has been found as yet only in separate leaflets. These leaflets are large, from two to three inches long, one and a-half to two inches wide, either oval in outline or oblong ovate, and smooth. The veins and veinlets are thin and distinct, inflated near the base, emerging from an oblique or horizontal truncate broad base, many times forking in ascending, and but slightly arched. The leaflets have no trace of a medial nerve, and could not, therefore, be referable to the genus *Nephropteris*, Brgt.

But as it has been seen to be the case with species of this genus, other leaflets, taken from different parts of the same plant, may have another kind of nervation. Our species is related to *Neuropteris ingens*, Lind & Hutt., Foss. Flora, vol. 2, Pl. 91a, by the form and size of the leaflets, but it differs by the mode of division of the veins, which do not radiate from one common point, but ascend in slightly curving lines to the borders from an enlarged base, where they become parallel, resembling, in that manner, the nervation of an *Odontopteris.* In our species also, the veins, though inflated near the base, are not as distinct as in the English species, which is compared to *Neuropteris au-*

riculata, Brgt., a plant which has not yet been discovered in our Coal Measures. The two specimens figured in this Report, have been found in the concretions of Mazon creek, the first one, fig. 5, by Mr. John Collins, to whom the species is dedicated. Other and larger leaflets of the same species have been obtained from the same place.

NEUROPTERIS CAPITATA, Sp. nov.

Pl. vii, fig. 1, and Pl. viii, fig. 9.

FROND or part of frond bi-pinnately divided, triangular in outline or tapering upwards from an enlarged base; pinnæ linear, with alternate, oblong, short, very obtuse, broad, contiguous pinnules, and a proportionally very large triangular obtusely pointed terminal leaflet, obtusely lobed on each side near its base. Medial nerve, none; veinlets scarcely visible to the naked eye, coming out from the narrowed base of the leaflets, strongly arched towards the borders, with numerous bifurcations. At the upper part, or near the point of the frond, as seen in Pl. vii, fig. 1, the pinnæ become shorter, less divided, and at last mere pinnules attached to the rachis by a broad pedicel. All leaflets are unsymmetrical at the base, being auricled or elongated downwards, or toward the main rachis, and merely rounded on the other side.

The general appearance of this species is somewhat similar to that of *Neuropteris Loschii*, Brgt., from which it is readily distinguished by its proportionally broader, round-topped pinnules, more abruptly cut at the base, its polished smooth surface, and the large terminal triangular leaflet. The large specimen figured is from Murphysborough; the other has been found in concretions at Mazon creek. The same species is abundant in the roof shales of the main four-feet coal bed at Yellow creek, Ohio.

NEUROPTERIS FIMBRIATA, Lesqx.

Pl. vi, fig. 4.

Cyclopteris fimbriata, Lesqx.

Journ. Bost. Soc. Nat. Hist., 1854, p. 416.

This species has also been published in part, and from isolated leaflets, in the Geol. Rep. of Penn., p. 855, Pl. iv., fig. 17 and 18, as a *Cyclopteris*. The specimens now on hand represent it with a pinnate frond having an undulating, flexuous, round, finely striate rachis, marked with points as if it had been scaly, which bears alternate, distant, broadly oblong or ovate, sometimes nearly round leaflets, entire at the round auriculate base, attached to the rachis by a broad pedicel. These leaflets are finely fringed from the middle upwards by long, undulating, narrow laciniæ. The veins which come out parallel from the broad pedicel and divide three or four times in ascending, are thin but distinct, slightly arched towards the borders and ascend to the top of the fringes. The specimen figured here from the concretions of Mazon creek, and found by Mr. S. S. Strong, seems to show that the species was a climbing fern resembling by its nervation and its mode of division a *Lygodium*. It has been supposed that the fimbriate leaves were the fruiting part of a species, which in its sterile form has entire leaflets, as it happens with some ferns of our time. But the fringe is not inflated, and the laciniæ, though very distinct in some specimens, do not show any trace of remains of sporanges. Like the former species, this one is, by its nervation, a *Nephropteris*, at least so far as it is known. It varies much in the size of its leaflets, some being still smaller than those figured here, while most of the others found detached from the stem, and which are broad oval or nearly round in outline, are about two inches or more in diameter. It is one of the finest and rarest species of our Coal Measures, though it has been found at different places over the whole extent of the N. American coal fields. When this species was first published, no plant of this kind had yet been found in the Coal Measures of Europe, but recently Prof. Heer has given in his *Urwelt der Schweiz*, under the name of *Neuropteris lacerata*, Heer, l. cit., p. 12, fig. 11, a species which has a near relation to ours. It is a round leaflet, bordered by a narrow fringe, which, unlike ours, is nearly regular with equal narrow divisions. As far as can be seen from a mere woodcut, the species is a truly different one. Prof. W. P. Schimper, in his *Palæontologie vegetale*, seems to consider both species as identical, for he says of *Neuropteris* (*Cyclopteris*) *lacerata*, Herr, that it is found at Saarbruck and in some places in North America. If both species are identical, our name has the right of precedence, and should be preserved, it having been published, with description, in 1854, in the Journal of the Bost. Soc. Nat. Hist.; and in 1858, in the Report of the Geological Survey of Penna., with figures and description, while Prof. Herr's species was published ten years later.

NEUROPTERIS VERMICULARIS, Lesqx.

Pl. vii, fig. 1, 2, 3.

This species, described in the 4th vol. of the Geol. Report of Kentucky, p. 434, has not before been figured. The frond is apparently tripinnate, with linear lanceolate somewhat obtuse pinnæ, and alternate, oblong very obtuse leaflets, placed at a short distance from each other. They are slightly narrowed in the middle, turned upwards or a little scythe-shaped, and nearly round, and equal at the corners of the base. The terminal leaflet, fig. 3, is oblong obtuse, regularly and equally undulate-lobed on both sides. The nervation is particularly distinct, the medial nerve being short and thick, and the veinlets distant, twice forking in curving to the borders, round, deeply marked, easily detached from the substance of the leaves, polished and thus appearing like pieces of rain worms. The main rachis is broad, straight, and irregularly striate. The general appearance of this species is like that of the large forms of *Neuropteris rarinervis*, Bunb., but its nervation is far different, the veinlets in this last species being flat, or looking as if formed of two parallel lines.

Found in the concretions of Mazon creek.

NEUROPTERIS VERBENÆFOLIA, Lesqx.

Pl. vi, fig. 5 and 6.

FROND pinnate; rachis round, slightly and regularly striate; leaves alternate, varying in length from half an inch to four inches and a-half, proportionally broad, ovate lanceolate-obtuse in outline, truncate at the base, regularly serrulate-toothed on the borders, attached to the rachis by a broad pedicel, medial nerve narrow but distinct; veinlets distinct and distant, thin, moderately arched in ascending to the borders, forking twice, the last divisions descending to the point of the teeth.

The figure and description given of this species in the 2d vol. of this Report, p. 431, pl. xxxvii, fig. 1, are imperfect, being made from the only specimen found at the time. Better specimens now on hand show that this fern evidently belongs to the genus *Neuropteris*, not only by its nervation, but by its ramification and the position of the leaves on the rachis. The species nearest to this is *Neuropteris crenulata*, Brgt., easily distinguished by its elongated narrower leaves, with crenulate rather than toothed borders, and the thickness of its veinlets. Our fig. 5 represents a specimen whose upper leaflets, scarcely dentate, have the surface wrinkled around, and marked by points of irregular size, placed without order, which resemble traces of fructification, the epidermis appearing as if it had been perforated by glomerules of spores placed under it. This peculiar appearance may result from the process of maceration. It is too obscurely marked to merit more than a passing mention.

NEUROPTERIS RARINERVIS, Bunb.

Pl. viii, fig. 1 to 6.

The specimens figured 1 to 4 on this plate, from the concretions of Mazon creek, bear round leaflets, apparently attached on both sides of a secondary rachis, as are generally the pinnules of a *Neuropteris*. According to this appearance we should have not only to consider these leaves as representing a new species, but also to accept the genus *Nephropteris* or *Cyclopteris* for their classification. But I think that the parts represented in fig. 1 and 2, are not fragments of a secondary pinna with alternate pinnules attached to it, but only parts of primary pinnæ with the basilar leaflets of the secondary pinnæ attached to them, in the same way as such leaflets are attached along the rachis in fig. 6, which represents a fragment of pinna of *Neuropteris rarinervis*.

This remarkable specimen is also from Mazon creek. As is easily seen, it shows a primary rachis with the base of its diversions marked by the remains of the secondary branches and the two basilar leaflets on each side of them. If this branch were longer, we should see these basilar leaflets more and more enlarged, becoming round farther down, and then showing the same forms as we see on fig. 1 and 2. In vol. 2, p. 429, in a foot-note of this Report, mention is made of a specimen from Newport, R. I., which bears on the same part of a frond two round cyclopteroidal leaflets attached at the axil of secondary pinnæ, while the same pinnæ bear true neuropteroidal oblong pinnules, with a medial nerve. As this specimen elucidates the position of the two kinds of leaflets, and as it is the only one found as yet elucidating this peculiar difference, I have figured it fig. 5, as affording the most conclusive representation of the unity of both the genera *Neuropteris* and *Nephropteris*. This figure, I think, demonstrates that all the leaflets represented in our plate viii, fig. 1 to 6, belong to the same species. The cyclopteroidal leaflets of this species vary in size from little more than half an inch to four or five inches in diameter.

NEUROPTERIS INFLATA, Lesqx.

Geol. Rep. of Ill., vol. ii, p. 431, Pl. xxxvii, fig. 2.

Though a few specimens of this species have been found in the concretions of Mazon creek since its description was made, these specimens do not indicate in the nature and characters of this plant anything more than was formerly known. All these specimens have only two basilar? round inflated leaflets, of a thick coriaceous substance, without any traces of lateral branches. One of the specimens has the leaflet of one side lacerated, or cut in lanceolate linear laciniæ, much like the leaves published in the Geol. Report of Penna., p. 856, Pl. v, fig. 5, as *Cyclopteris Germari*, Gopp? As the specimen which I considered then (1854, Bost. Soc. of N. H.) as referable to Goppert's species, is not in my possession, I cannot, by comparison, ascertain if it is or is not identical with ours. Moreover, as both the European and the American species are founded on mere fragments of specimens, we must consider the species which they represent as still uncertain or doubtful.

NEUROPTERIS CORIACEA, Sp. nov.

Pl. viii, fig. 7 and 8.

WE have of this species only a small branch in a concretion from Mazon creek. It is part of a secondary pinna, lanceolate in outline, bearing nearly opposite oblong lanceolate obtusely pointed pinnules, turned upwards at an acute angle to the rachis, and gradually diminishing in size to the terminal leaflet, which appears proportionally broad. As it is broken from the middle upwards, its form is unknown. The texture of the leaflets is thick, and the smooth epidermis is inflated along the veins and veinlets in an irregular manner, as seen in fig. 8, enlarged.

This inflation may be caused by groups of spores or elongated sori, placed along the veins which are twice forked, and along their divisions. A swelling of this kind on the veinlets of *Neuropteris cordata*, Brgt., and which is also often remarked on specimens of our *N. hirsuta*, has been considered by European authors as representing organs of fructification. As the form and thickness of the inflation is very irregular, it may be caused on both species by some casual influence in the process of mineralization. The basilar leaflets of this species show a tendency to be divided into lobes and pinnules, having thus the same form as some of those of *Neuropteris Desorii*, Lesqx., to which this species is related, and from which it differs only by the thick epidermis, and by the more distant ramification of the veinlets. The small fragment mentioned in vol. ii of this Report, p. 430, as possibly belonging to *N. Desorii*, Lesqx., is referable to this species.

GENUS DICTYOPTERIS, Gutbier.

Aldr. u Verst., p. 62.

FROND at least tripinnate, pinnæ linear-lanceolate, bearing alternate leaflets much variable in size, ovate-oblong obtuse squarely cut at the base, with equal lobes on both sides, or with the lower lobes slightly elongated. Medial nerve none, or merely basilar; veinlets anastomosing from the base, arched towards the borders, but irregularly undulating in ascending, and forming by their contact an oval-polygonal reticulation.

DICTYOPTERIS RUBELLA, Sp. nov.

Pl. vii, fig. 2 to 6.

FROND bi or tripinnate; pinnæ linear-lanceolate, with alternate oblong or oval-lanceolate leaflets, attached to the rachis by a broad pedicel. The inferior basilar lobes, as is generally the case in the species of the genus *Neuropteris*, are slightly longer or protracted into a little obtuse auricle. The terminal leaflet, somewhat broader and longer, is oval in outline, obtuse, and cut on one side into a short obtuse lobe, fig. 2. The leaflets of the large inferior pinnæ are more distant, larger, truncate at the base, slightly scythe-shaped outwards; and the axillar pinnules, still larger and cyclopteroidal in form, are attached around the stem by a half circular notch, nearly surrounded by two broad auricles. The veins, anastomosing from the base without medial nerve and in their undulations forming oval-polygonal elongated meshes, curve towards the borders, where the last divisions end in arched close lines.

In this species, found in soft shales at Murphysborough, the epidermis or substance of the leaflets has become, by maceration, separable from the stone, and is easily obtained in lamellæ. Whole pinnules can be got in that way without any earthy substance adhering to them; and in that semi-opaque state their texture and nervation are easily studied with the glass. The veins present, under the microscope, the appearance marked in fig. 2.

When the 2d vol. of this Report was published, no species of this genus had been found in Illinois. Now this new one, obtained in numerous and well preserved specimens, not only adds a beautiful species to the flora of the Coal Measures, but furnishes us new evidence on some questions concerning the vegetation of plants of this kind. First, our specimens prove, beyond doubt, the close relation of this genus with the former. The form of the fronds, of the pinnæ, of the leaflets, and their variety in size and shape, are exactly alike in both genera. Truly but for its nervation, we should have in our new *Dictyopteris* a *Neuropteris* scarcely distinguishable from *Neuropteris Loschii*, or *Neuropteris tenuifolia*. But further, the peculiar nervation, as well as the peculiar reddish color of the plant in its fossil state, permit us to identify the large leaflets of the species of this genus with the small ones, or afford the proof that for *Dictyopteris* as for *Neuropteris*, the large round cyclopteroidal pinnules, always found isolated, really belong to species represented by pinnæ bearing small leaflets of a widely different form. It would not certainly be possible to admit specific identity between the leaves represented, pl. vii, fig. 2, and those of fig. 5, without those peculiarities of structure remarked in both.

The species of *Dictyopteris* are rare in the Coal Measures. In the United States none had as yet been found but *D. obliqua*, Bunb., whose remains are very abundant at some places in Pennsylvania and Ohio, and which have also been found, but rarely, in Kentucky and Arkansas. By the form of its leaflets, its ramification f c. f, this last species is related to *Dictyopteris Brongnarti*, Gutb., the only species of this genus known in the Coal Measures of Europe. For *D. neuropteroides*, Gutb., described from a few small leaflets, is, according to Prof. Ellinghausen, a true *Neuropteris*, and *Dictyopteris cordata*, Roem., according to the remarks of the author himself, is a variety of *Neuropteris cordata*, Brgt., as his *D. Hoffmanni* seems to be a variety of *D. Brongnarti*, Gutb.

GENUS ODONTOPTERIS, Brgt.

Ill. Geol. Report, vol. ii, p. 482.

ODONTOPTERIS SUBCUNEATA, Bunb.

Pl. viii, fig. 10 and 10b.

From the specimen figured here from Mazon creek, it is clear that the fern published under this name in the Ill. Geol. Report, vol. ii, p. 433, pl. xxxvi, fig. 3, does not belong to this species. It is referable to *Odontopteris heterophylla*, Lesqx., loc. cet., p. 433, pl. xxxviii, fig. 2 to 5. The pinnules of *Odontopteris subcuneata*, Bunb., are opposite, proportionally longer and narrower, slightly narrowed in the middle, and enlarged to the very obtuse point. The veins are closer to each other; and as the English author has figured them, they curve downward before coming into the border of the rachis, and descend in fascicules along the somewhat decurrent base of the leaflets. In their lower part and just above the decurrent border, these leaflets are all strongly bowed. The terminal pinnule is broken above the middle; it is proportionally large, and appears to be oval-obtuse, entire or without any lateral lobe. I owe this specimen, the most perfect known of this peculiar species, to the kindness of Mr. Michael Prendel, of Morris, Ill.

ODONTOPTERIS BRADLEYI, Sp. nov.

Pl. viii, fig. 11.

NOTHING is known of this species but the leaflet, which has been copied in our figure. It is lanceolate pointed, somewhat contracted at its base in a broad pedicel. The veins are closely approached, sharply and deeply marked, dichotomous in ascending, nearly straight from the base, where they become parallel. The veins and veinlets of this species are too close to each other and too numerous to admit it as related to *O. heterophylla*, Lesq., which has its leaflets sometimes pointed. It may be compared only to *Odontopteris acuminata*, Ll. and Hutt, of the Oolite.

In concretions from Mazon creek.

ODONTOPTERIS SCHLOTHEIMII, Brgt.

Veg. foss., p. 256, pl. 78, fig. 5.

Rarely found in the concretions of Mazon creek, but abundant in the roof shales of the coal at Morris. The frond of this fern is very large, at least tripinnately divided; the alternate secondary pinnæ linear lanceolate, two inches long or more, and more or less deeply and regularly cut in alternate round, oblong lobes, or in oval-lanceolate obtusely pointed pinnules, varying from one-fourth to half an inch long. The veins and veinlets, with the disposition and divisions as marked in Brongniart's description, are thick, parallel, and generally forking once. In the large leaflets there is a medial depression looking like a medial nerve, the veins generally branching from a medial point. Though somewhat obscure, the specimens or this species at Morris are easily identified by the reddish-brown color of the epidermis.

GENUS ALETHOPTERIS, Sternb.

This genus is admitted, for the disposition of the fronds and for their division, as it is characterized by Goppert in his Systema, p. 175, and for the position and the form of the fructifications, as modified by Geinitz, in his Verstein, p. 27. It therefore contains not only species whose fructifications are marginal and continuous, but species also bearing in some division of their veins, or between them, round or starlike groups of sporanges like those of the genur *Asterocarpus*, Gopp. As the fructification of some of our species is unknown, or is not clearly seen through the substance of the leaves, some are admitted into this genus from mere analogy in the divisions and in the form of their fronds, and in their nervation.

ALETHOPTERIS MAZONIANA, Sp. nov.

Pl. ix, fig. 1 to 8, and Pl. xiii, fig. 5 and 6, fruiting.

FROND evidently large, many times pinnately? divided, dichotomous at the end of the divisions; pinnæ long linear, tapering slightly toward the points, either pinnately or bi-pinnately lobed; lobes oblong entire obtuse, joined near the base and perdendicular to the rachis, or longer broader linear obtuse regularly undulate, lobed on the borders, and more or less distinct and distant to the base. Medial nerve thin, but deeply marked; veins of the simple pinnules rather curved upwards, forking once only at the middle; in the undulated lobed leaflets, one of the veins ascends to the sinus, and is twice forked upwards.

The divisions of the frond of this species appear to have been opposite to each other, and distant, at least in the upper part of the frond, as it is seen fig. 7, representing a specimen which at first seems to belong to another species. As the nervation, the broad deeply grooved rachis, and the form of the pinnules are the same, it is evident that it merely represents the upper part of a frond or of a pinna, whose ramification is either in the whole, as in the *Gleichenia* of our time, truly dichotomous, or pinnate and dichotomous, as in some of our species of *Pteris*. The fructifications of this species as represented pl. xiii, fig. 5 and 6, would rather refer it to the genus *Gleichenia* or even *Polypodium*, than to *Pteris*. They appear like round, oval, enlarged sori, placed along the borders on both sides of the leaflets, between the branches of the veins, as seen fig. 6 enlarged. The outline only of the fructifications is observable through the substance of the leaflets in the form of an oval ring, depressed in the middle, indicating perhaps the point of attachment of an indusium.

This fine species has as yet been found only in the concretions of Mazon creek, where it is tolerably abundant.

ALETHOPTERIS CRENULATA, Brgt.

(Fruiting) Pl. xiii, fig. 14 and 15.

Though the nervation of this fragment is scarcely well enough preserved to permit the ascertaining of its disposition, it is evident, from the form of the pinna and of the leaflets, that it represents a fruiting branch of this species. The leaflets united at the base, regularly crenulate around, with the borders apparently reflexed, are marked near the margin by two rows of scars of round sori, each placed in a curve of the crenulation, as seen fig. 15 enlarged. The medial nerve, like the veins, are obsolete, and the details of the nervation could be somewhat distinctly observed only on one of the leaflets. In comparing our figures with that of the sterile parts, published vol. ii of this Report, pl. 39, fig. 3, the essential characters are seen to be the same. This species is generally rare, and its mode of fructification has not been observed before.

It occurs in the concretions of Mazon creek.

ALETHOPTERIS HYMENOPHYLLOIDES, Sp. nov.

Pl. x, fig. 1 to 4.

FROND large, tripinnately divided, with primary and secondary pinnæ alternate, turned upwards, ovate-lanceolate in outline, decurrent in a narrow-winged rachis; secondary pinnæ or pinnules either entire, short oblong, obtusely pointed, joined at the middle in acute sinuses; or longer, divided nearly to the base, ovate-lanceolate and pinnately cut into regular obtuse lobes with obtuse sinuses. In the short divisions, the medial nerve only is distinguishable; in the larger ones, the veins, though obscure, appear pinnately branching from the medial nerve in an acute angle and forking at the middle. But for this kind of nervation, this species should be considered as a *Hymenophyllites*.

Mazon creek; in concretions of clay iron ore.

ALETHOPTERIS INFLATA, Sp. nov.

Pl. x, fig. 5 and 6.

NOTHING has been found of this species but the fragment figured here. It shows part of a linear pinna, gradually tapering to the point, divided into broadly ovate, or ovate obtusely pointed lobes, enlarged and united near the base, marked in the middle by a short thick nerve pinnately divided by five or six pairs of arched veins forking once. The fructifications are marked by oval inflated large fruit-dots, placed at the base of the leaflets, one only on each side of the enlarged medial nerve. The surface covering these inflated fruit-dots is wrinkled above, and around them, as seen in fig. 6 enlarged.

In considering the form of its fructifications, this species should be separated as the type of a peculiar genus.

Mazon creek; in concretions of clay iron ore.

ALETHOPTERIS HALLII, Sp. nov.

Pl. x, fig. 7 and 8.

FROND bi-pinnate; pinnæ perpendicular to the straight round main rachis, linear, alternate, narrow, close to each other, apparently short, merely cut on the borders by obtuse narrow lobes, either emarginate or square at the top, separated by short obtuse sinuses. Veins and veinlets deep and narrow, the primary ones ascending to the middle of the sinuses and forking twice upwards as seen in fig. 8, enlarged.

This species is closely related to *Alethopteris serrula*, Lesqx., Penna. Geol. Report, p. 865, pl. xii, fig. 1, differing from it by its shorter, broader pinnæ, placed close to each other; by its more obtuse lobes, and by the primary divisions of the veins, ascending to the middle of the sinuses, and not to the point of the lobes. Though in both species the borders of the pinnules are apparently reflexed, these differences are too marked to be considered mere varieties of the same species. Nevertheless, it might be possible that the specimens from Illinois represent a sterile frond, and those of Pennsylvania fruiting branches of the same species.

Mazon creek; in concretions found by Mr. M. S. Hall.

ALETHOPTERIS EROSA, Gein.

Verst., p. 29, Pl. 32, fig. 7–9.

PECOPTERIS EROSA, Gutb. (1843.)

Numerous and large specimens referable to this species have been found by Mr. S. S. Strong, in the roof shales of the coal at Morris.

The American plant merely differs from that of Europe by the longer divisions of the three-pointed lobes, and by the much longer pinnæ. The same fronds, or parts of fronds, bear sterile and fruiting pinnæ; those especially in the upper part. They are scarcely lobed, and covered by groups of sporanges, apparently confluent, and of undeterminable form. Prof. Geinitz figures and describes them as star-like.

ALETHOPTERIS CRISTATA, Gein.

Verst., p. 29, Pl. 32, fig. 6.

Pecopteris (*Diplagites*) *cristatas*, Gutb.

We have only small fragments, which, by the size of the pinnæ and by their divisions, are referable to this species. As the nervation is obscure, it cannot be positively seen whether they do not perhaps represent different parts of a frond of the former species. The European specimens, at least so far as they are figured, leave us in the same doubt about the value of the species.

From the shales of the Morris coal.

ALETHOPTERIS MURICATA, Gopp., Syst.

Pecopteris muricata, Brgt.

Hist. veget. foss., p. 352, Pl. 97.

Good but small specimens of this species have been obtained in the concretion of Mazon creek. It appears to be rare in the western coal fields.

ALETHOPTERIS PLUCKNETI, Gein.

Verst., p. 30, Pl. xxxiii, fig. 425.

Nothing proves better than this species the insufficiency of our classification of the fossil plants of the Coal Measures. First, a *Felicites* for Schlotheim, it has been a *Pecopteris* for Brongniart, an *Aspidites* for Goppert, and now an *Alethopteris* for Geinitz. The form of its pinnules, especially those of the lower pinnæ, seems to force its admission into this genus. Some good specimens have been obtained from the shale of Morris, especially part of a tertiary pinnæ, bearing large leaflets with a broad base, lanceolate pointed, scythe-shaped in form, with the borders divided by alternate obtuse lobes, whose surface is generally convex and polished. This form is the same as that published by Geinitz, being in all its parts larger than the common one generally found in the eastern Coal Measures.

ALETHOPTERIS SPINULOSA, Sp. nov.

Pl. xi, fig. 1 and 2.

FROND broad, bi-pinnate; primary pinnæ apparently long linear slightly tapering toward the point, divided into alternate broad, half an inch long, oval leaflets, joined above the base, cut at the obtuse top in sharp spiniform short teeth, separated by obtuse sinuses; main stem round, regularly and narrowly striate; secondary rachis straight and flat; medial nerve thick and enlarging toward its slightly decurrent base, with five pairs of alternate veins slightly curved upwards and forking at the middle.

This fine species has no relation, even distant, with any other published as yet from the Coal Measures. The veins and veinlets are not deep, but very distinct by their black color, as seen in fig. 2, enlarged.

From the roof shales of the main coal at St. John's, Perry Co.

ALETHOPTERIS FALCATA, Sp. nov.

Pl. xi, fig. 3 and 4.

THE specimen figured represents a part of a simply pinnate frond, or of a pinna with simple leaflets attached to a main broad smooth rachis, by their whole unconnected base. These pinnules, about two inches long, are linear-lanceolate obtusely pointed, scythe-shaped and entire. The veinlets perpendicular to the half round medial nerve, are very close to each other, very thin, either simple or forked from the base.

On account of its broad curved rachis, of its long nearly linear leaflets attached to it by their whole base, especially of its obsolete nervation, the veinlets being scarcely perceivable to the naked eye, this species rather resembles a Cycas than a fern. With a strong glass, the veinlets are seen as marked on fig. 4, enlarged, and these indicate the true relation of the plant.

The specimen may represent a part of a frond in the process of unfolding its leaves, which appear as being pressed upon each other on the lower side of the rachis, and at the same time, still half uncinnate. It may also be the representative of a species in its full development. Some *Lomariæ* of our time resemble it, by the nervation and the form of the leaflets. It has no relation with species known from the Coal Measures.

Mazon creek; in concretions of clay iron ore.

ALETHOPTERIS SOLIDA, Sp. nov.

Pl. xi, fig. 5–7.

THIS species is, like the former, known only by a fragment of a frond or of a pinna. It is pinnately divided into narrow leaflets, attached to a proportionally very broad flat rachis, by the enlarged base of a thick medial nerve. These pinnules, a little longer than one inch, perpendicular to the main rachis or slightly turned upwards, are linear obtusely pointed, disconnected at the enlarged rounded base, and entire. They bear along the borders, at equal distances from each other, round groups of sporanges, apparently divided star-like into five round dots, as marked in fig. 7.

By the position of its *sori* and of its leaves, our species is a *Polypodium*. It resembles by these characters the species published by Prof. Brongniart, under the name of *Phlebopteris polypodioides*, Veg. foss., p. 372, pl. 83, fig. 1, and if the nervation should prove to be the same, the American species would be distinguishable only by the broad rachis, the enlarged base of the medial nerve, and the separation of the leaflets. No trace of secondary veins or veinlets is observable on the specimen, which is in a concretion from Mazon creek. Our species is also related to *Polypodites elegans* and *Polypodites Lindleyi* of Goppert.

ALETHOPTERIS LANCEOLATA, Sp. nov.

Pl. xiii, fig. 1 to 3.

THE specimens represent two parts of simple pinnæ or of fronds, with alternate linear lanceolate obtusely pointed leaflets, oblique on the rachis, or slightly scythe-shaped, narrowed at the base to half their width, and rounded to the point of attachment to the rachis; entire on the borders and smooth on the surface. Main or medial nerve half round, moderately thick; secondary veins attached to it in a very acute angle, alternately branching from the base in veinlets curved inwardly, as marked fig. 2, the upper ones ascending to the borders of the leaflets, the lower ones becoming confluent in ascending.

Of the two specimens which have been seen of this species, and which are figured here, that of fig. 1 seems to represent the upper part of a frond, while the other, fig. 3, looks like the terminal part of a pinna, and therefore the species is apparently bi or tripinnate. The nervation resembles that of the following species, but the veins and their divisions are more oblique, more slender and of a more delicate texture.

Mazon creek; in concretions.

ALETHOPTERIS EMARGINATA, Gopp.

Syst. foss., p. 274, Pl. xvi, fig. 1 and 2.

Pl. xiii, fig. 4.

We have in the concretions of Mazon creek many separate leaflets of the same form and of the same size as the one figured. The borders of these linear obtuse leaflets are slightly and equally undulate-lobed, as formed of pinnules connate to the top; the nervation is nearly similar to that of the former species, the secondary veins being only more open to the medial nerve, or nearly perpendicular to it, while their branches, generally more marked and thicker, ascend to the border of the leaflets. This kind of nervation is that of Goppert's species. But in our American specimens, the leaflets are broader, shorter, and by the increasing depth of the divisions of the borders, they become by degrees cut into lobes nearly to the base, and then are undistinguishable from *Pecopteris unita*, Brgt., except, perhaps, by the medial nerve or secondary rachis, half round and not quite as thick, and by a thinner texture of the leaves. The fructification is marginal, in round distinct *sori* which sometimes become irregularly scattered by compression.

GENUS PECOPTERIS, Brgt.

PECOPTERIS STRONGII, Sp. nov.

Pl. xiii, fig. 7-9.

FROND simply pinnate or poly-pinnate, pinnæ linear tapering above to a point, slightly narrowing toward the base. Pinnules alternate, perpendicular to the striated narrow rachis, nearly one inch long and proportionately narrow, linear obtuse, often slightly enlarged at the obtuse point, attached to the rachis by their whole, sometimes enlarged base, disconnected and often distant, the distance between them being sometimes as wide as the breadth of the leaflets, becoming closer to each other towards the point of the pinnæ, where they are shorter and connate at base. Fructification, marked by scars of broad round *sori*, with a concave point in the centre, placed near the borders of the leaflets, close to each other, ten to twelve on each side of the pinnules. Their place in relation to the veins and veinlets is unknown, the substance of the leaflets being thick, coreaceous, and the nervation obsolete.

As it is seen in fig. 7 and 8, enlarged, the borders of the leaflets are slightly undulate, an irregularity apparently caused by the compression of the *sori* expanding the margin, or passing out of it, for in fig. 9 all the pinnules are entire on the borders. This last specimen seems to represent a small frond rather than a pinna, for the leaflets turn downwards towards its base, as is the case in some simple fronds of species of *Polypodium* of our time. By its form and the position of the *sori*, our species could also be compared to *Aspidium Wrightii*, Mitt. of Cuba. Its place is, therefore with the *Polypodites* or *Aspidites* of Goppert.

The specimen fig. 7, is in a concretion form Mazon creek; the others on shale from Morris.

Found by Mr. S. S. Strong.

PECOPTERIS SQAMOSA, Sp. nov.

Pl. xii, fig. 1 to 4; Pl. xiii, fig. 10 and 11, fructif.

FROND evidently bi or tripinnately divided, triangular or lanceolate in outline, with a thick rachis, half an inch or more at its base, covered to the top of its last divisions with long, linear lanceolate pointed scales, either straight and appressed to the stem, or open and diverging all around, even sometimes appearing as dried up and crumpled as in fig. 2. The rachis of the last divisions is proportionally broad as seen in fig. 1 and fig. 4, enlarged, and is also either scaly or marked with crowded points indicating the base of the scales. Secondary pinnæ long, linear, slightly tapering to an obtuse point, flexuous or curved upwards, bearing alternate, unequal, narrow linear, obtuse, oblong leaflets, nearly perpendicular to the rachis, reflexed on the borders, very close to each other, or often contiguous for their whole length, marked with a deep medial nerve, but no trace of veins. These leaflets, generally more or less irregular in their length, have their fructification indicated by small round dots, placed in two rows, close to the borders; the dots are numerous and distinct; their relation to the veins and veinlets is unknown.

The species is quite distinct and only distantly related to *Pecopteris platyrachis* Brgt. The specimen represented, pl. xii, fig. 4, shows a part of a frond of this species, in its process of development. The divisions appear still unopened and the outline only of the secondary pinnæ with mere traits of medial nerves, are indicated by flakes of scaly matter.

This specimen is upon shale from the roof of the coal at Colchester; the other specimens figured are in concretions from Mazon creek.

PECOPTERIS SILLIMANI, Brgt., Veg. foss., p. 353.

Pl. 96, fig. 5

This is one of the rarest species of our Coal Measures. The few specimens which I consider referable to it, are small and incomplete; one of them is from Mazon creek, in concretions of clay iron ore.

PECOPTERIS BUCKLANDI, Brgt., Veg. foss., p. 319.

Pl. 99, fig. 2.

The specimen representing this species, distinctly shows the character indicated by the author. The pinnæ are straight, nearly horizontal (four inches long with the end broken off), the leaflets oblong, somewhat lanceolate obtuse, but not quite as obtuse as in Brongniart's figure, slightly scythe-shaped outwards, etc. The pinnules are of a thick coriaceous substance, concave, and deeply impressed upon the stone.

Found in a concretion on Little Vermilion river, by Dr. J. C. Winslow.

PECOPTERIS CANDOLLIANA, Brgt., Veg. foss., p. 305.

Pl. 100, fig. 1.

One good distinct specimen, in a concretion from Mazon creek, while numerous specimens from the same locality have branches, with characters intermediate between this species and *Pecopteris cyathea* of the same author.

PECOPTERIS HEMITELOIDES, Brgt., Veg. foss., p. 314.

Pl. 108, fig. 1.

The specimen from Mazon creek, is half a concretion, representing part of a pinna, bearing oblong, slightly pointed leaflets, disconnected at the base, with borders inflated, and a double row of large *sori*, unlike any other hitherto seen of this genus. These *sori* open by a transverse split, agreeing with Brongniart's fig. 2 A in every peculiarity of form. Our specimen does not show any trace of nervation.

PECOPTERIS VILLOSA, Brgt., Veg. foss., p. 316.

Pl. 104, fig. 3.

This species is the most abundant of all in the concretions of Mazon creek, which show it in its multifarious forms. The nervation does not appear to have been seen by European palæontologists. Brongniart does not give any details of it, and Geinitz indicates it as simple, or with veinlets forking once only, which is totally at variance with its true nature. The concretions contain numerous parts of the plant preserved in a state of partial maceration, either with pinnæ whose substance is destroyed, and which have nothing left but the outlines of their leaflets, and the entirely free veins and veinlets; or pinnæ half preserved, one part of which bears leaflets with the villous epidermis, while the other part has the veins and veinlets free of epidermis, and quite distinct. From the form of its pinnule, the multiple divisions of its pinnæ, and of its veins, this *Pecopteris* is exactly similar to *P. polymorpha*, Brgt., the veinlets dividing once or twice or more, according to the place and size of the pinnules.

PECOPTERIS ARGUTA, Brgt. (fruiting.)

Pl. xiii, fig. 12 and 13.

The part of a pinna, as represented in the figure, bears leaflets, connate at the base, oblong, lanceolate obtuse, somewhat shorter, more pointed, and more distinct than is generally the case in sterile pinnæ of this species. But as the nervation, as well as the crenulate-toothed borders of the leaflets, are similar to those of *Pecopteris arguta*, and as these peculiar characters are not known in any other species of the coal, I consider this specimen as representing its fruiting part, which was before unknown. The *sori* appear like inflated dots placed just at the point of the simple veins or rather like conical *sori*, with the point to the inside of the leaflets and the enlarged opening outside at the point of the teeth, as marked, fig. 13, enlarged. Their form is distinct; with a strong glass they even appear filled with a pulverulent matter. According to the form and the position of these fruit-dots, the species resembles an *Aspidium*, and should be placed in the genus *Aspidites*, Gopp. Sterile pinnæ of this species are not rare in the shales at Morris.

PECOPTERIS ELEGANS, Germ.

Polypodites elegans, Gopp., Syst., p. 344.

Pl. xv, fig. 10.

We have in abundance, in the concretions of Mazon creek, specimens which agree in every point with the figures and description of this species. Pinnæ, bearing linear leaflets, entire on the borders, round at the top, marked by medial nerves from which branch in an acute angle simple veins, ascending straight to the borders, or sometimes slightly curving upwards. But the characters here indicated are so variable and passing by such inappreciable transitions to those of the true *Pecopteris unita*, Brgt., that after the examination of many hundred specimens, it is impossible to point out a single trait which could be described as distinctive of one of these species. I therefore consider this *Pecopteris elegans*, Germ., as a variety of *Pecopteris unita*, Brgt.

PECOPTERIS ASPIDIOIDES, Brgt., Veg. foss., p. 311.

Pl. 112, fig 2.

Found at Mazon creek; rare; seen only in two specimens.

PECOPTERIS ABBREVIATA, Brgt., Veg. foss., p. 337.

Pl. 115, fig. 1 to 4.

Numerous and very fine specimens in concretions from Mazon creek are referable to this species, rather by the figures given of it by Geinitz in his Versteinerimgen, than to those of Brongniart. The secondary pinnæ are short, all equal, the veins and veinlets much inflated, the pinnules more generally disconnected f. c. f. It is altogether a different species from *Pecopteris Miltoni* Brgt., to which the German author unites it as a variety, at least, if we consider our American specimens identical, which, however, may represent a new species.

PECOPTERIS DENTATA, Brgt.

Veg. foss., p. 336, pl. 124.

A fine species found in large specimens in the shales of the coal at Morris, and also in the concretions of Mazon creek.

PECOPTERIS FLAVICANS? Presl.

Sphenopteris flavicans? Presl.

Sternb., Vers., vol. ii, p. 127. Pl. xxxviii, fig. 1, *a*, *b*, *c*.

From Mazon creek also, and in concretions, we have obtained a number of specimens of a species which appears closely related to this species, if it is not identical with it. They represent parts of fronds or pinnæ, bipinnately divided; primary divisions alternate, open, straight or slightly flexuous, linear, bearing alternate, oblong, short, obtuse pinnules, connate at their base, slightly decurrent, with a decurrent medial nerve; alternately branching in simple veins, two or three on each side, turning inwards in ascending or straight to the border. The fruit dots are marked in a double row near the borders of the leaflets, apparently placed upon the veins. The main rachis and its divisions are deep and grooved. But for the position of the *sori* and of the thick epidermis of its leaflets, this species could be referred to *Oligocarpia Gutbieri*, Gopp., the disposition of the deeply marked veins and the form of the pinnules being alike. As this *Pecopteris flavicans* is not mentioned by any recent author, not even by Unger, and as it is known only by the short description and the incomplete figures given of it by Sternberg, our species is referred to it with doubt.

PECOPTERIS CHŒROPHYLLOIDES, Brgt.

It is remarked, vol. 2, p. 443 of this Report, that this species was still uncertain, having been found only in incomplete specimens. It has been obtained since from the roof shales at Colchester in large and good specimens. Except *Pecopteris Cistii*, Brgt., *P. velutina*, Lesqx., *P. Newberryi*, Lesqx., all the species of *Pecopteris* enumerated in the 2d vol., have been since found in Illinois.

GENUS STAPHYLOPTERIS.

Presl. in Sternb. Vers., ii, p. 174.

Count Sternberg, in his Versuch, loc. cit., defines this genus merely as: *inflorescence or fructified panicles of ferns, analogous to those of Botrychium or Aneirnia.*

The only species described by the author as the type of his genus: *Staphylopteris polybotrya*, from the Tertiary of Europe, represents a small group of round sporanges. In our American species here described, these *sori* have various forms. But it is convenient to consider them under the same generic name, till their relation to sterile fronds, or their true generic affinity can be ascertained. To this genus, therefore, I refer all agglomerations of sporanges of various forms, either borne upon separate plants, or upon separate segments of a plant, like those of our species of *Botrychium*, without visible remains of leaves, or whose connection to frond-bearing leaves can not be traced, and is unknown.

No species referable to this genus has been found as yet in the Carboniferous strata of Europe, a fact which led Palæontologists to suppose that ferns bearing fruits in separate panicles did not exist at the time of that formation. From our Coal Measures, we have previously obtained only *Staphylopteris stellata*, Lesqx., Arks. Geol. Rept., vol. ii, p. 309, pl. 2, fig. 2 and 3, from the Sub-Conglomerate coal of Arkansas. The discovery and publication of the following species is, therefore, a valuable contribution to the fossil flora of the coal.

STAPHYLOPTERIS WORTHENI, Sp. nov.

Pl. xiv, fig. 1 and 2.

FROND bi-pinnate, ovate lanceolate in outline; pinnæ linear, gradually tapering to an obtuse point, short, one inch long near the base of the frond, scarcely half an inch near the top perpendicular to the main rachis; pinnules alternate triangular, formed of an agglomeration of three or five *sori* apparently attached to a main pedicel, but without trace of leaves. The main rachis of this fruiting segment of a fern is proportionally thick, three lines at its base, finely irregularly striate, the branches or pinnæ appearing attached rather upon it or around it than along its borders; the rachis of the branches is also thick, smooth, and on both sides of it are attached the groups of *sori*, three to five in number, in a kind of pyramidal position, with a thick short pedicel in the middle. The *sori*, when unopened, are round, marked on the flattened surface by four or five lines diverging from the center to the circumference. Fig. 2*a*. When opened the sporanges appear placed like the rays of a star around a central point. These sporanges, oval, elongated or gradually enlarged outwards from the narrow point of attachment, deeply concave, finely striate within, are all turned to the same side, viz: the point downwards and the branches tending obliquely upwards; in that way the upper *sori* of the pinnæ have the point towards the rachis, while in the lower ones it is turned from it: see fig. 2, enlarged twice, and fig. 2 *b*, enlarged four times. The sporanges are deeply marked or excavated in the stone, which is still more deeply penetrated by the point, and this point appears, as said above, to have been attached to a common pedicel by filaments now destroyed.

Found in a concretion from Mazon creek; discovered by Mr. M. S. Hall.

STAPHYLOPTERIS ASTEROIDES, Sp. nov.

Pl. xiv, fig. 6 to 10.

FROND tripinnate, with straight alternate branches; primary pinnæ lanceolate pointed or tapering to a point from an enlarged base; secondary divisions alternate linear, merely formed of narrow, filiform, obliquely straight branches or common pedicels, bearing groups of sporanges pinnately attached to them in pairs and opposite; *sori* round at first and before maturity, opening at maturity in five lanceolate-pointed laciniæ around a central round point, and forming a star (fig. 7 and 7 *b* enlarged).

This fruiting species is still more remarkable than the former. Groups of *sori* resembling round dots, fig. 8, are seen on the same piece of shale, but on the reverse. They apparently belong to the same species, and seem to have been detached before maturity from their pedicels, whose remains are still marked by dark lines, fig. 8, fig. 9, enlarged twice, and fig. 10, enlarged about ten times. In this last figure dark but absolute lines are seen, apparently showing the suture of walls. In the pinnately divided part of the frond, fig. 6, all the *sori* are opened, and their envelope is still attached to short pedicels, apparently placed opposite to each other. The details of the form of the sporanges are easily recognized, but those of their ramifications, or the point and mode of attachment of the *sori* are rendered indistinct by the superposition of the groups of sporanges. The specimen is on shale from Morris, and was contributed by Mr. Jos. Even.

STAPHYLOPTERIS SAGITTATUS, Sp. nov.

Pl. xiv, fig. 3 to 5.

THIS species has a bi-pinnate frond, as seen on a specimen from the shales of the coal at Morris, too large to be figured. The divisions are alternate; the thick secondary rachis is decurrent on the main stem, which is also broad and smooth. The double celled sporanges are linear, attached by their backs, and pressed against each other in horizontal rows. The enlarged pedicel of the sporange cells is, before maturity, apparently at least, folded in the middle, and both rows of sporanges are joined together by their back, forming in that state slightly scythe-shaped cylinders, obtuse at both ends, attached to the pedicel by a dorsal membrane, and marked all around by the ring-like outlines of sporanges (fig. 3*a*). More generally the sporange-cells are open side by side on each side of the dorsal support, and the sporanges appear then in two convex rows, fig. 4 and 5. In some specimens on concretions from Mazon creek, where small branches of this remarkable species are finely preserved, the *sori* or sporange bearing cells are deeply immersed in the stone, generally leaving around them an empty space, as seen in fig. 3*b* and 3*c*; they are thus isolated and their form is easily ascertained. No traces of leaflets have been seen in connection with this species, which has as yet been obtained only from Morris and from Mazon creek.

GENUS SPHENOPTERIS, Brgt., Ill. Geol. Rep., vol. ii, p. 435.

SPHENOPTERIS SCABERRIMA, Sp. nov.

Pl. xv, fig. 1 and 2.

FROND tripinnate, primary pinnæ lanceolate, curved downwards, flexuous; secondary divisions perpendicular to the verrucose, broad, round rachis, linear lanceolate pointed, one to two inches long, distinct and somewhat distant alternate; pinnules lanceolate acute, gradually diminishing to the point, distinct to the base, horizontal, irregularly cut on the borders or entire with borders irregularly expanding and undulating by crushed groups of sporanges or of scales; surface rugose, marked by round small convex points resembling small dots, produced by groups of sporanges placed on the lower surface. All the plant, even the thick, primary rachis, is covered with verrucose points, evidently indicating the base of scales, or hairs, with which the plant was covered, and which are still indistinctly seen on some part of the secondary branches. The frond of this species was evidently a large one, the pinnæ being more than six inches long.

The whole appearance of the plant is like that of some species of *Cheilanthes* of our time, especially of *Cheilanthes vestita*, Schwarz. The species should therefore be classed in the genus *Cheilantites*, Gopp. Nevertheless, the group of *sori* appears to cover the whole under surface of the leaflets, a position which is not similar to that of the *sori* of a *Cheilanthes*. On shales from Morris.

SPHENOPTERIS GRACILIS, Brgt.

Pl. xv, fig. 3 to 6.

FROND bi or tripinnate; primary pinnæ or fronds triangular in outline, taper-pointed, slender; secondary pinnæ linear lanceolate, alternate and distant, open, curved upwards, flexuous, bearing alternate divisions, cordate, lanceolate in outline, deeply cut on each side in three to five irregular obtuse or pointed lobes, as seen in fig. 4, 5, 6, enlarged; medial vein somewhat inflated like its pinnate divisions, which branch once or twice to the borders, according to the size of the lobes.

The surface of the leaflets is quite smooth. By its slender, half round secondary and tertiary rachis, and the general form of the pinnæ and of the divisions, our species agrees well enough with that published by Brongniart, Veg-Foss., p. 197, pl. 154, fig. 2. But the author describes and figures the lobes of the pinnules as being more regular, longer, regularly tridentate at the point, while those of our specimens are always either more or less irregularly cut, or entire, and also either pointed or obtuse. The difference in the form and size of the lobes of the pinnules of the same pinnæ, indicate for this species, as seen from our fig. 4, 5 and 6, a great disposition to vary, and the more essential characters being identical, I can but consider the American specimens as representing the same species as that of Prof. Brongniart.

It is found in fine large specimens on the shales over the coal at Morris.

SPHENOPTERIS MIXTA, Schp. Pal. Veg., p. 382.

Sphenopteris sinuosa Lesqx, ined.

Pl. xv, fig. 7 and 8.

This species is the same which, from incomplete specimens, was in the second volume of this Report, page 435, considered as doubtfully referable to *Sphenopteris rigida*, Brgt. It has a tripinnate or polypinnate frond, the specimens being covered with numerous secondary pinnæ, of which one only is figured here. Pinnæ branching at a right angle from a broad winged smooth rachis, bearing alternate lanceolate secondary divisions, with a half round comparatively broad and regularly sinuous rachis. The pinnules obliquely attached upon each of its convex flexures are oval, lanceolate pointed, regularly divided on each side into three to five half round lobes. The medial vein which, like its divisions, is thin and somewhat obscure, alternately branches into each lobe of the pinnules, the branches forking above the middle. The epidermis is thick, the surface convex and somewhat rough. This species appears essentially distinct from *Sphenotopteris rigida*, Brgt., by its broad winged rachis, the form of the pinnules and of their divisions, the slightly rough surface, etc.; nevertheless there may be some error of description or of illustration of the European species, which is marked as having its surface entirely smooth, while the figure shows it covered with points or rugose.

Abundant in the shales of the coal at Morris.

SPHENOPTERIS TRIFOLIATA, Brgt. Veg. Foss., p. 202.

Pl. 53, fig. 3.

In the shales of Colchester; found by Prof. A. H. Worthen.

SPHENOPTERIS ELEGANS, Brgt. Veg. Foss., p. 172.

Pl. 53, fig. 1 and 2.

Two fine specimens of this species have been obtained from the concretions of Mazon creek; by Mr. M. S. Hall.

GENUS HYMENOPHYLLITES, Gopp and auct. Ill. Geol. Rep., vol. ii, p. 436.

In preserving this genus, with its characters too vaguely defined as it is in vol. 2 of this Report, p. 436, it would be advisable to subdivide it as follows:

§ 1. *Hymenophyllites* proper, containing species with a generally membranaceous delicate frond, pinnately divided, the primary divisions alternate or dichotomous, decurrent on the rachis and ultimate lobes linear obtuse, either simple alternate or irregularly divided; nerves percurrent pinnately branching, ascending, simple in each lobe. This section contains *Hymenophyllites* and *Trichomanites*, Gopp.

§ 2. *Aphlebia*, including species with fronds of various sizes and forms, generally with a broad rachis and more or less irregularly divided, the divisions rather dichotomous or pinnatifid, entire or variously laciniate lobed, the lobes sometimes enlarged and recurved; veins parallel and numerous from the base of the fronds, dividing in fascicles from the rachis in each primary division, and passing by subdividing, as simple veinlets to the point of each lobe. To this section are referable the genera *Aphlebia*, *Schizopteris*, *Rhodea*, *Pachyphyllum*, etc. auct.*

---

*W. P. Shimper, in Pal. Veg., makes for this section a new genus, *Rhacophyllum*.

§ 3. *Schizopteris* proper, to which belong the species with a frond generally laciniate, or cut in linear erect or curved divisions, sometimes enlarged at the top, marked with thin parallel veins ascending from the base of the frond to the top of the lobes without branching, being split in fascicles with the divisions. To this section belong merely the genus *Schizopteris*, as characterized by Prof. Brongniart for his *Schizopteris anomala.*

It is difficult to separate these sections in genera by reliable and permanent characters. Some of the species which are considered as *Schizopteris* by authors, as *Schizopteris adnascens*, Ll. and Hutt, for example, have the nervation and a mode of division of their fronds similar to those of some *Hymenophyllites*, while species referable to this last genus have, with a regular mode of division a nervation by disconnected fascicles of veins, like species of *Aphlebia* and *Schizopteris.* This is the case with our *Hymenophyllites splendens.* The plants of the two last divisions are little known, their apparently soft tissue having often been destroyed by maceration. I have described and figured here some remarkable forms, especially from the concretions of Mazon creek, whose study may throw some light upon the nature and conformation of these singular vegetables.

§ 1. HYMENOPHYLLITES (proper).

HYMENOPHYLLITES ALATUS, Brgt.

Veg. foss., p. 180, Pl. 48, fig. 4.

This species is mentioned in the Ill. Geol. Rep., vol. ii, p. 437, as presenting some characters at variance with the European one. Good specimens of it from the concretions of Mazon creek, show it to be identical.

HYMENOPHYLLITES TRIDACTYLITES, Brgt.

Veg. foss., p. 181, Pl. 50.

Good specimens of this fine species have been lately procured from the roof shales of the coal at Morris, by Mr. S. S. Strong.

HYMENOPHYLLITES TRICHOMANOIDES, Brgt.

Veg. foss, p. 182, Pl. 48, fig. 3.

A small specimen from the same place as the former.

HYMENOPHYLLITES MYRIOPHYLLUM, Brgt.

Veg. foss., p. 184, Pl. 55, fig. 2

The straight, strong main rachis and its branches, like the form and divisions of the leaflets, entirely agree with the author's description and figures of this species. Some of the terminal divisions of the pinnules appear on our specimen as slightly inflated at the point. It is not possible to see whether this swelling is caused by fructification, or by the remains of some part of the half destroyed epidermis.

Roof shales of the coal at Morris, contributed by Mr. S. S. Strong.

HYMENOPHYLLITES SCHLOTHEIMII, Brgt.

Veg., foss., p. 193, Pl. 51.

This species should be placed in its natural order after *Hymenophyllites tridactylites*, Brgt., but our specimen, a very fine one, is described here from the remarkable likeness of its divisions when deprived of their epidermis, with the former species. Except a few entire leaflets which have preserved their integral form, the whole specimen represents merely the veins and their divisions, without any substance of the leaflets attached to them; in that state, the species could easily be confounded with the former or considered as a new one.

From the same place as the former, and due also to the successful researches of Mr. S. S. Strong.

HYMENOPHYLLITES DELICATULUS, Brgt.

Veg. foss., p. 185, Pl. 58, fig. 4.

This species, also from the shales of Morris, could be admitted, by some of its parts deprived of their epidermis, as identical with that of the same name of Sternberg, which has been considered as a *Cheilanthes* by Goppert. The thin membranaceous substance of the pinnules in our *Hymenophyllites*, is generally partly or totally effaced by maceration.

HYMENOPHYLLITES TENUIFOLIUS, Brgt.

Veg. foss., p. 190, Pl. 48, fig. 1.

Well characterized by its straight broad rachis, the position of the pinnules, the narrow lobes, etc. The epidermis is also partly destroyed.

Roof shales at Morris; a small specimen.

All the foregoing species of *Hymenophyllites* are described as *Sphenopteris* by the author.

HYMENOPHYLLITES SPLENDENS, Sp. nov.

Pl. xix, fig. 2*a* and 2*b*.

FROND tripinnatifid; primary pinnæ at a right angle to the flattened main rachis, broadly lanceolate in outline; secondary pinnæ alternate, narrowly ovate-lanceolate, oblique decurrent on the flexuous alate rachis, alternately two or three lobed on each side, the lobes divided in two or three lanceolate, somewhat obtuse teeth. Veins in fascicles from the base of the secondary pinnæ, separating in each lobe, one of the divisions ascending to the point.

The surface of the whole plant is polished shining, of a reddish brown color. This species resembles the variety of *H. furcatus*, Brgt, called *H. membranaceous*, by Gutbier, which is common enough in Pennsylvania, especially in the upper part of the sandstone at Pottsville and Mauch Chunk. It differs, however, essentially, by the thick substance of the leaves which easily separates from the stone, by much thicker veins, merely approached in fascicles but not united at the base of the secondary pinnæ, which are longer, narrower, more equally and pinnately divided in lanceolate pointed teeth.

This species appears intermediate between *H. furcatus*, Brgt., and *H. stipulatus*, Gutb.

Abundant in the roof shales of the coal at Colchester and Morris.

HYMENOPHYLLITES INFLATUS, Sp. nov.

Pl. xvi, fig. 6.

A tripinnately divided part of a frond, with primary divisions broadly oval in outline pinnately cut into alternate obovate obtuse inflated lobes, either simple or parted again in short obtuse divisions; nervation obsolete, the veins apparently branching in each division of the leaves, and simple.

This species is intermediate between the two sections of *Hymenophyllites*, having the mode and regularity of division of the first, the thick inflated leaflets without distinct nervation, like some species of the second. It is distantly related to *Sphenopteris Rutæfolia*, Gutb., Verst., p. 42, pl. x, fig. 10 and 11, from which it differs by the form of its more elongated, narrow, inflated pinnules, by the obsolete nervation, etc.

From the roof shales of the main coal, Duquoin.

The specimen is a large piece of shale covered with fragments of the plant, none larger than the one figured.

§ 2. APHLEBIA.

HYMENOPHYLLITES ADNASCENS, Ll. and Hutt.

The two specimens figured, pl. xvi, fig. 7 and 8, from the roof shales of the coal at Morris, exactly represent the species of Lindley, as it is figured and described by Geinitz, in his Versteinerungen, p. 20, pl. xxv, fig. 7 to 9. But I cannot recognize an identity between the plants represented in these figures. The one, fig. 8, of ours, has the lower divisions short lanceolate obtuse, irregular in their directions, with thin parallel veinlets, and the upper ones narrower, curved, marked also by thin parallel veins branching into each lobe; while the other, fig. 7, has dichotomous or forking, linear, narrow branches, without trace of veins or veinlets. The first of these forms agrees with the description and figures given by Lindley, vol. 2, p. 58, pl. C and CI, who compares the plant to some *Lygodium* or *Hymenophyllum*, but I am disposed to consider the other as a peculiar species. Our fragments are nevertheless too small to allow a precise and satisfactory description. Prof. Lindley considers his species as a climbing fern, twisted round the stem of a frond of *Sphenopteris crenata*, to which it is evidently attached, while Prof. Geinitz thinks that it is fixed in small bundles to the stem, like a parasitic plant. The State Cabinet at Springfield possesses specimens of a large fern whose stem, like that described by Lindley, is bordered by bundles of leaves of the same *Hymenophyllites.* The specimen is obscure, and it is not possible to decide how they are attached to it.

HYMENOPHYLLITES LACTUCA, Gutb.

This species is more rarely found in our Coal Measures than its near relative, *H. Clarkii*, Lesqx. The State Cabinet has a very fine specimen of it in a concretion from Mazon creek. It is distinguished from *H. Clarkii* by its broad enlarged fronds and narrow laciniæ. These fronds or rather pinnæ, on one side of the rachis, which are only visible in part, appear placed in a row, like the alternate divisions of a fern. As the epidermis of some of these pinnæ is destroyed by maceration, the veins and veinlets are distinct, and are seen passing in bundles from the rachis, separating more and more in curving into each division, to end by a simple veinlet, ascending to the point of the acute ultimate lobes.

HYMENOPHYLLITES ARBORESCENS, Sp. nov.

Pl. xvii, fig.1 .

STEM long, (the specimen, though broken, shows more than one foot of it,) straight, about one inch broad at its lower end, two-thirds of an inch at its upper part, marked in its length by obscure lines apparently formed by bundles of veinlets and alternately divided in thick oblique branches, more or less regularly and deeply lobate; lobes alternate, simple and linear elongated, or bi-trifid, of various lengths and obtusely pointed.

The divisions of this plant are rather dichotomous, like those of species of *Lycopodiacea*, than pinnatifid like those of ferns. They are merely a continuation of a main axis thrown out in various directions. The substance appears to have been a compound of cellular soft tissue, intermingled with bundles of continuous vessels, forming veins or veinlets, and, by mere separation, ascending to the last divisions of the frond. There is no trace of branching of veins, but merely of divisions of fascicles of vascular tissue. The species, in its general form, resembles *Schizopteris pachyrachis*, a species of the Keuper.

Found at Morris on a large piece of shale, and kindly presented by Mr. Jos. Even.

HYMENOPHYLLITES CLARKII, Lesqx.

Pl. xvi, fig. 1 and 2.

The description of this species is given in vol. ii of this Report, p. 438, pl. xxxix, fig. 7, from a small specimen. It is abundantly found in the concretions of Mazon creek, and, though very variable, preserves the characters which separate it from *H. Gutbierianus*, Gein., viz: its broad, round, or very obtuse divisions, and the great thickness of the leaves, which were evidently hard and coriaceous; for they are not flattened on the stone as in *H. Gutbierianus*, but enter it, and mark on it a deep impression, as a hard body only can do. Of the two remarkable specimens figured here, the first appears to represent a plant with a long twisted or climbing stem. The principal axis is round, grooved, and has its surface roughened, and marked with points or scars, as if it had been covered by hairs or scales. As the stem of the second specimen, which seems to represent a young plant evidently of the same species, is smooth, these points may be the scars of rootlets or suckers, serving as adhesive agents to help the climbing process. The young plant, fig. 2, has a short stem already curved or twisting, and at its base, some filaments resembling rootlets. It would, therefore, be rational to conclude, from these specimens, that the plants which they represent were attached to the ground or to some soft substance, like decayed wood, by rootlets, but were at the same time climbing plants. This would explain the position of *H. adnascens* upon the broad rachis of some ferns.

HYMENOPHYLLITES GUTBIERIANUS, Ung. Gen. and Spec., p. 132.

The true species, as figured by Geinitz, is in the State Cabinet, in specimens from Colchester, found by Prof. A. H. Worthen.

HYMENOPHYLLITES THALLYFORMIS, Sp. nov.

Pl. xvi, fig. 3 to 5.

The specimen here figured, represents only part of a frond, which, in its whole, appears to have been large and roundish in outline, with undulate borders and undulate rugose hairy surface. From the emarginate border of the frond, protrude cylindrical branches, either erect or creeping, whose form is totally different from that of the frond. These branches, half an inch thick, are covered with ob-lanceolate, obtuse scales or leaves, narrowly striate, as marked, fig. 4, enlarging upwards and closely imbricate. As the scales are mostly crushed upon each other, it is not possible to see if these stems are fruit-bearing, like the branches of a *Lycopodium*, or are merely the base of the stems of some fronds of ferns, and thus only a different representation of the same organs of the plant. The specimen is good, the various parts of the plant are distinct, and the connection between the branches and the frond is evident.

This kind of development may be compared to that of the *Marchantiaceæ* and of the *Lycopodiaceæ* with the fronds of the first, and the fruiting-stem of the last family of plants. I suppose that the fragment, represented fig. 5, belongs to the same species. It is apparently the plant in the first development of its frond. The specimen, fig. 5, is in a concretion from Morris; the other is on shale from Colchester. The same species has been found also on the shales from Morris.

HYMENOPHYLLITES STRONGII, Sp. nov.

Pl. xviii, fig. 1.

STEM half an inch broad, erect, undulately veined or striate in its length, bearing alternate leaves? covered with long thick hairs or scales, diverging all around. It is not possible to see the form of the leaves or divisions, which may be merely part of branches. On the left part of the specimen the stem is smooth and has the appearance of a stem of some species of *Hymenophyllites* of this section; on the other side, which is unhappily broken, the borders are fringed with long straight hairs, appearing to come out from another part of the stem. From this it is hardly possible tc decide if the specimen represents a true *Hymenophyllites* or merely some disconnected part of a Lycopodiacæous plant.

In a concretion from Mazon creek, collected by Mr. S. S. Strong.

§ 3. SCHIZOPTERIS.

HYMENOPHYLLITES MOLLIS, Sp. nov.

Pl. xviii, fig. 2 to 6.

LEAVES or fronds formed of groups of thin filaments, emerging from a common support, apparently parasitic, enlarging in growing up or by grouping together, and by compression taking various forms; the laciniæ or filaments are generally united together without distinct nervation.

This is still one of those singular plants of the coal epoch which baffles every attempt at analysis, when one is trying to compare them with representatives of our existing vegetation. This kind of vegetable is doubtfully referable to this section of this genus. Fig. 2 represents a kind of tubercle, resembling a piece of decayed wood, with traces of an axis in its middle and irregular cavities, bordered all around by a short fringe of these filaments which appear as growing out of it in an incipient state of vegetation. These filaments represented separately, fig. 3, are like linear, thin, short, obtuse laciniæ, united together and without nerves, or with thin parallel veinlets. In fig. 4, these filaments, much elongated, are separated in the middle and near the base in various ways, appearing to come out from a mere point and to enlarge in ascending. In fig. 5, the point of attachment of the whole group of filaments is well marked, and from it, the laciniæ seem to be attached or to grow upon one another like the subdivisions of a kind of *Fungus*. Fig. 6 represents a group or a heap of these filaments which appear attached and growing upon each other like parasitic plants, the whole by compression being crushed, forming a kind of flattened ball. In all these varied appearances of the same plant, no distinct trace of a true nervation can be seen. The lines marked on the figures, exactly as they are perceivable on the stone, are more or less inflated in places, and can be considered, as well as the borders of the filaments, as true veins. They do not branch, and are mostly parallel. They may, nevertheless, represent the parallel groups of vessels which characterize the species of this section of *Hymenophyllites*. The substance of these plants was evidently soft, for the specimen fig. 6 represents a compound of many of these leaves appressed and crushed together, and the impression is merely of a thin surface.

All the specimens figured here have been found in concretions at Mazon creek, and nothing except *Schizopteris anomala*, Brgt., is comparable to this kind of vegetation.

GENUS PACHYPTERIS, Brgt.

Frond simply pinnate or bipinnately divided, bearing upon the same horizontal plan, opposite entire coreaceous pinnules, with a medial nerve, or without any trace of nervation, narrowed towards the base, not joined to the rachis. The peculiar disposition of the lobes or leaflets of those plants, is similar to that of the pinnules of some ferns. The genus was established by the celebrated author for two species of the Oolite of England.

PACHYPTERIS GRACILLIMA, Sp. nov.

Pl. xix, fig. 6 to 8.

THE specimen represents only simple branches or simple pinnæ, bearing on each side, but on the same plan, opposite very oblique, linear, oblong, obtuse, narrow leaflets, joined by their base to the enlarged border of the rachis, or of a medial nerve, and thus appearing decurrent upon it. The substance of the leaflets is thick, coriaceous, without any trace of a medial nerve. Fig. 6 shows, apparently, a peculiar kind of ramification by innovation.

The specimen from which the figures and descriptions are made, is on a large piece of shale whose surface is covered by a quantity of simple branches of this plant. They are placed without any kind of order, crossing each other in various directions, as if they had been strewn on the stone, and therefore the kind of divisions marked in the figure, and abnormal, if this plant belongs to a fern, may be merely caused by the casual superposition of two branches joined by their bases. The form of the leaves, their peculiar position along the stem on the same side of it, resembling the divisions or lobes of some ferns, and their mode of attachment, indicate the close relationship of this plant to those published by Prof. Brongniart as *Pachypteris*. In some of our branchlets the basilar prolongation of the pinnules along the rachis? of the pinnæ has become détached by compression, and they appear in that way as bearing, at the base, a long, linear auricle. The pinnules are a little enlarged to the very obtuse point, as seen in fig. 8, enlarged four times, and in fig. 7, enlarged twice.

On shale, from Morris, collected by Mr. Jos. Even.

LEAVES OF UNCERTAIN OR UNKNOWN AFFINITY.

GENUS CORDAITES, Ung.

Ill. Geol. Rep., vol. ii, p. 443.

CORDAITES ANGUSTIFOLIA, Sp. nov.

The roof of the main coal at Duquoin and St. Johns is in places covered to a thickness of six inches to one foot, with remains of flat, narrowly equally striate, long linear leaves, one to one and a-half inches broad, which, as yet, have not been found in connection with any stem.

From their linear form and from the narrow striæ marking their surface, I refer these leaves to the genus *Cordaites*, Ung., being unable to see the characters which separate these ribbon-like leaves into two genera, viz. *Cordaites* and *Noeggerathia*.

GENUS SPHENOPHYLLUM, Brongt.

SPENOPHYLLUM CORNUTUM, Sp. nov.

Pl. xix, fig. 1 to 5.

MAIN stem round, half an inch broad, articulate at equal distances (about one inch), inflated at the *nodi* or points of insertion of the whorls of leaves, smooth but obscurely ribbed in the length, divided about at right angles by long straight branches bearing whorls of five or six leaflets, joined at the base; leaflets equal, fan-like in outline, broadly cuneiform to the base, divided from below the middle into seven to nine linear, pointed, nearly equal lobes; veins distinct, flat, four to five at the base of each leaflet, forking once, each division ascending to the top of one of the lobes (fig. 5 enlarged).

It is a well characterized and distinct species, and in studying it at Colchester, I have found among the shales a great number of broken specimens, representing different parts of it, and have seen all the leaflets, from the largest one around the broad part of the stems, to those of the branchlets, presenting the same form and kind of division. It can be compared only to a variety of *Sphenophyllum emarginatum*, Brgt., figured by Geinitz in his Verst. pl. xx, fig. 6. But it differs indeed in its essential characters: broader stems and leaflets, peculiar and equal divisions, and a different kind of nervation. The branching, as seen, fig. 1, is also peculiar for a species of this genus. It is worth remarking that the branches of this plant are mixed on most of the specimens with the remains of a somewhat obscure *Calamites*, resembling *Calamites Suckowii*, Brgt, a coincidence which may be casual. In any case I could not trace any evident connection between the two plants, and the stems of this *Sphenophyllum* do not appear as equally and deeply striate as are generally the branches of *Calamites*.

Roof shales of the Colchester coal.

SPHENOPHYLLUM FILICULMIS, Lesqx., Geol. Rep. Penn., p. 853.

Pl. i, fig 6.

Nodule from Mazon creek; F. H. Bradley.

Fruiting catkins of *Sphenophyllum*, referable to *Asterophyllites ovalis*, Lesqx. Penn. Geol. Rep., p. 851, pl. i, fig. 2, are found in the concretions of Mazon creek, and in the shales of Morris.

GENUS ANNULARIA, Brgt. Ill. Geol. Rep., vol. II, p. 444.

ANNULARIA LONGIFOLIA? Brgt.

Pl. xxi, fig. 1 to 3.

STEM thick, round, narrowly and equally striate, articulate, divided into opposite diverging branches placed crosswise in ascending, bearing at the articulations whorls of ovate-lanceolate obtusely pointed flat leaflets, marked by a broad medial nerve.

This species is represented in the concretions of Mazon creek, by two kinds of specimens, with different appearances. Those figured in our plates seem to belong to the upper, still undeveloped part of the plant. The branches and leaflets are crowded and pressed upon one another in a scarcely distinguishable mass, presenting sometimes, as in fig. 1, the appearance of a peculiar species of *Sphenophyllum*. In fig. 2, the branches and leaves are more distinct, and the form of the leaflets is distinguishable as marked fig. 3, magnified. On another specimen, which was obtained too late to be figured, and which shows the plant in its full development, the stem about one foot long, half an inch thick at the base, regularly striate in length, is articulate at the distance of one inch by whorls of leaves of the form described above, and two opposite branches diverging in open angles from under the leaves, and crosswise in ascending. The leaflets, one inch long, one-sixth of an inch broad, twelve to fourteen in each whorl, are joined at their base. The point of attachment of the leaflets upon the stem and the branches, is marked around the articulation by small, semi-lunar inflations or knots, corresponding in number with the leaflets, and placed just above the point of attachment. The plant represented by the two specimens figured, pl. 21, can be compared with what Prof. Geinitz has described and figured in his Verst., p. 10, pl. 16, fig. 1, under the name of *Asterophyllites foliosus*, Ll. and Hutt. The form of the leaflets being indistinguishable in the above mentioned figures, a close comparison with our species cannot be established. It is nevertheless evident that it does not represent the same plant as ours, as its stem, though striate, like a *Calamites*, is not marked like ours by any knots of the articulations. From the mode of division, the form and the size of its leaflets, this species of ours is a true *Annularia*. The one described and figured by Messrs. Lindley and Hutton as *Asterophyllites foliosus*, and which does not even resemble that of Geinitz, has linear lanceolate, pointed, narrower leaflets, and is not comparable to this, which I refer with doubt to *Annularia longifolia*, Brgt., considering it rather a distinct species, under the name of *Annularia calamitoides*, Schp. Prof. Schimper has published, in his Pal. Veget., p. 349, pl. xxvi, fig. 1, a new species which, though the leaves are narrower and more acute, is nearly related to this one, if not identical with it.

ANNULARIA INFLATA, Sp. nov.

Pl. xx, fig. 1 to 3.

THE essential difference which separates this species from *Annularia longifolia*, Brgt, consists in the form of the leaflets, which are ob-lanceolate, obtuse, subcylindrical or inflated upwards without trace of medial nerve, or with merely an obscure line indicating a central vessel, while the leaflets of *A. longifolia*, are flat, with recurved borders and marked by a thick, flat medial nerve. The difference in the form of the leaflets is seen in fig. 3 and 4, and their comparative sections, 3*b* and 4 *b*. The stem of this species does not appear as thick as in *A. longifolia*, and the branches come out in opposite direction from the middle of the whorls, or rather from above them, than from below.

The specimens figured are from the concretions of Mazon creek, where both species are abundant, and may be distinguished always by the same characters, without any form appearing intermediate. It may be that we have here two parts of the same species, one representing branches growing out of or above water under atmospheric influences, with dry, flat leaflets; *A. longifolia*, the other, representing the floating part, sustained in water by bladderly-inflated leaflets, as shown in our species. But if it is so, it is peculiar that this, so different a form of a common species, has not been found elsewhere and described before.

GENUS ASTEROPHYLLITES, Brgt.

Ill. Geol. Rep., vol. ii, p. 444.

ASTEROPHYLLITES RIGIDUS, Brgt.

Pl. xxi, fig. 4 and 4 *b*.

This species has been referred to *Asterophyllites longifolius?* Brgt, p. 444, vol. ii, of this Report. The whorls of the leaflets, very close to each other, indicate the top of a branch. The leaflets are about three inches long, not quite rigid, not open as in *A. rigidus*, but they are of a hard, solid texture, exactly linear, marked in the middle by a deep medial nerve, reflexed on the borders, canaliculate on the lower surface, thus presenting the true characters of *A. rigidus* as recognized by other and better specimens from the same locality—Mazon creek. The true *Asterophyllites longifolius*, Brgt., has been found on shales from Morris, by Mr. Jos. Even. It greatly differs from *A. rigidus* by its leaves, which are soft, flat, scarcely marked by the medial nerve, ascending along the stem and undulate, and by the narrower, nearly smooth stems and branches.

ASTEROPHYLLITES GRANDIS, Ll. and Hutt.

Foss. flora, i, Pl. xvii.

Found in fine specimens on the shales of the coal at Morris. Leaves still narrower, and whorls still more numerous than indicated by the description and plate of the English authors.

ASTEROPHYLLITES FOLIOSUS, Ll. and Hutt.

Foss. flora, i, Pl. xxv.

Not rare in the concretions of Mazon creek.

ASTEROPHYLLITES TUBERCULATUS, Brod., p. 159.

In the shales at Morris.

GENUS EQUISETITES, Sternb., Vers. ii, pl. 43.

Stem fistulose, cylindrical, striate lengthwise, articulate, simple or branching at the sheathing articulation, sheaths attached under the articulations, erect, dentate.

EQUISETITES OCCIDENTALIS, Sp. nov.

Pl. xx, fig. 5.

WE have only one sheath of this species, the first trace of a true *Equisetites* found in the Coal Measures of this continent. The sheath is open or unfolded, somewhat broken in the middle, about three inches across, two inches long, regularly divided to about the middle by lanceolate, obtusely pointed teeth, marked by a strong nerve, which descends from the point of the teeth to the base of the sheath. The surface in the middle and between these nerves is irregularly wrinkled, and the base, in the line of connection with the stem, is marked by regular, half round notches, corresponding evidently with the striæ of the stem.

The specimen is from Mazon creek, a concretion where this part of the plant is distinctly preserved. Another specimen from the same locality, but in a bad state of preservation, contains also fragments of an *Equisetites*, whose specific relation cannot be recognized. It has the remains of a stem about one inch in diameter, with a lacerate sheath.

SELAGINIÆ, Endl.

GENUS LYCOPODITES, Brgt.

Ill. Geol. Rept., vol. ii, p. 447.

LYCOPODITES ANNULARIÆFOLIUS, Sp. nov.

Pl. xxi, fig 5.

STEM round, as seen in fig. 5 dichotomous, bearing opposite leaves, apparently united by two at the base, half embracing and slightly decurrent; leaves linear-lanceolate, obtusely pointed, slightly narrowed to the base, marked with a medial nerve, disappearing above the middle, open or slightly reflexed.

The mode of branching of this species, by a peculiar kind of dichotomy observable in some *Lycopodiaceæ* of our time, the *Ruelliæ*, for example, indicates the nature of this peculiar plant. It is not quite evident that the leaves are approached by pairs, and placed in two parallel rows or distichous; the specimen shows nothing more definite than what is represented by the figure.

No species of *Lycopodites* of the Coal Measures has been as yet published having leaves of the same form and type as ours; the only one somewhat comparable to it is *Lycopodites macrophyllus*, Gold. Flor. Saar., i, p. 12, pl. 1, fig. 5.

On a concretion from Mazon creek; in the cabinet of Prof. A. H. Worthen.

LYCOPODITES MEEKII, Sp. nov.

Pl. xxvi, fig. 6 and 6*a*.

STEM very slender, about one-sixth of an inch thick toward the base, dichotomous, with continuous, elongated branches, scarcely diminishing upwards; leaves imbricated all around, narrow, linear, lanceolate, acute, erect, or slightly open and curving upwards at the point. As seen, fig. 6*a* enlarged, these small leaves are thick, concave on the inside, sharply pointed, not enlarged, but semi-embracing at the base, and without trace of a nerve.

This extremely fine and delicate *Lycopodites* may be compared to the upper branches of *Lepidodendron selaginoides*, Sternb., as figured by Ll. and Hutt., vol. 1, tab. 12; and also to *Lycopodites Stichlerianus*, Gopp., Silurian, p. 170, tab. 25. In our species the stem is longer, more slender; the leaves narrower and proportionally longer, and the ramification different.

On the roof shales of the coal at Morris.

GENUS SCHUTZIA, Goppert, Permian Flora, p. 161.

Stems either single or branching, bearing on short alternate pedicels small cones or strobiles of an ovate truncate form, a compound of imbricate, broadly linear pointed scales, united at the base.

SCHUTZIA BRACTEATA, Sp. nov.

Pl. xxi, fig. 6 to 9.

STEM proportionally thick, smooth, bearing alternate short pediceled cones or strobiles, about half an inch long, enlarged ovate from a narrow base, truncate at the top, slightly turned upwards, placed at the axil of a narrow linear bractlet, about one inch long and curved upwards. The cone is a compound of lanceolate pointed, concave scales, placed in spiral, closely imbricated and pressed upon one another, fig. 7 and 8; covering a transparent, yellowish membrane, formed of small, elongated, equilateral meshes: fig. 9, which enclose or support small granules of opaque, brown matter. These granules, scarcely the one-hundreth part of a millimeter in diameter, are of a roundish, irregular, polygonal form, agglomerated and separating with difficulty. Their size and irregularity of form prevent considering them as spores; they look rather like grains of pollen.

From the great difference in the form of the buds born on the stem, which cannot be accounted for, I think, by difference in maturity, it would appear as if the scape of this plant was bearing monœcious flowers, the ones in strobiles bearing pollen, the other fertile buds. These, as seen in *a*, fig. 6, have the appearance of an inflated receptacle, either naked or bordered at its top by foliaceous, narrow divisions. Two specimens of this plant have been found in the concretions of Mazon creek, and both present the same appearance. Some plants resembling ours have been described under the generic name of *Antholithes*. But this genus is still indefinite, and the plants referred to it really unknown. I have, therefore, placed this species for description in this new genus of Goppert, as more related to it by some of its characters.

GENUS LEPIDODENDRON, Sternb.

Ill. Geol. Report, vol. ii, p. 451.

The species of this genus, as it is well known, are characterized merely by the form of the cicatrices, which have been left by the base of the leaves upon the bark of the trees or of their branches. These cicatrices or bolsters vary indeed in size and also in their relative position, according to the thickness of the different parts of a tree, where they are examined. But this variety is far from being as marked as some authors, who have attempted to reduce the species to two or three, seem to suppose it. In following the course of the development of these scars on long stems of *Lepidodendron*, from parts measuring at least one foot in diameter to the smallest branches, they may be seen to vary in size and position according to the degree of activity of the vegetation at different times, and also on account of some irregular mode of growth; but their essential characters, viz.: their outline, the position of the vascular points, as also the form of the leaf scars surrounding them, is generally preserved and recognizable in the whole length of the stem. It is argued that for the genus *Lepidodendron*, we should have too large a number of species if we would consider the scars as specific characters. But the genus *Sigillaria*, so admirably studied by Prof. Brongniart, and after him by the most careful Palæontologists, especially by Goldenberg, whose acuteness of observation is beyond question, has a number of acknowledged species, at least double of those of the genus *Lepidodendron*. Goldenberg describes sixty-seven species of *Sigillaria!* and yet the specific characters are taken from the same vegetable organs, or from the cicatrices of the bark, which are certainly as much subject to variations in *Sigillaria* as in *Lepidodendron*. Why, then, deny the value of the species of one genus, and admit the reality of those of the other. The most marked species of *Lepidodendron* of our American coal fields, *L. modulatum*, *L. giganteum*, *L. clypeatum*, *L. vestitum*, *L. distans*, published in the Geological Report of Penna., have been found over the whole extent of our Coal Measures, and are recognized everywhere by their distinct characters from the form of their cicatrices. In collecting specimens on shale, for the State Cabinet, great care has been taken in comparing the largest possible number of specimens of the same species at the same place, not only to obtain the different parts of a plant, but also to carefully note the variations of the same plant under different circumstances. In this way it has been possible to ascertain the reliability of some doubtful species of *Lepidodendron*, and to unite in one some parts formerly referred to different species or even to different genera.

LEPIDODENDRON RIGENS, Sp. nov.

Pl. xxvii, fig. 1 to 3.

THE concretions of Mazon creek, which have generally preserved plants or their parts in their integrity, without deforming them by compression, have furnished, among other very interesting specimens, the branch of *Lepidodendron* which is copied in our figure. It shows distinctly the bolster, the point, and mode of attachment of the leaves, around the leaf scars, and the vascular vessels, or bundles, in their disposition in passing from the stem to the leaves, as in fig. 2. At the same time it proves that, in some species at least, the leaves of *Lepidodendron* were inflated, or somewhat cylindrical in their whole length, as marked in fig. 3, and not flat, as they are generally seen on the shales. These leaves were not hollow or tubulose; they are too stiff for that in this species at least, but were probably filled by cellular tissue traversed by three bundles of vessels. The form of these leaves does not appear to be exactly like the outline of the leaf scar, as they seem to extend and become flat on the sides in joining the scar, fig. 2, and in the cross section, fig. 3, enlarged, the leaf does not indicate any angular compression on the sides. The bolsters of this branch have not yet their definite form, and therefore the specific affinity, considered from these characters, can not be satisfactorily recognized. The narrower leaves and cicatrices distinguish it evidently from the following species, which it resembles by the length and straightness of the leaves.

LEPIDODENDRON MORRISIANUM, Sp. nov.

Pl. XXII, fig. 1 and 2.

THE cicatrices of this species are of three kinds. Under the surface or true cortex, they appear slightly upraised, like those of a *Knorria*, upon a short pedicel which is enlarged downwards, rough on the sides, with a flat rhomboidal top or leaf scar, marked like that of the surface by three vascular points, fig. 1*a*. The surface cicatrices are broadly rhomboidal, with the opposite sides nearly parallel, curved outside and the leaf scar placed near the top, rhomboidal obtuse above and below, acute on the sides and marked by three horizontal large vascular points. The medial line of the bolsters is merely indicated by two or three horizontal wrinkles, enlarged in the middle. These cicatrices of the surface, when covered with the base of the leaves and their coat of coaly matter, appear hexangular, fig. 1*b*. The leaves one foot long or more, one and a half line broad when flattened, are sharply marked by three vascular lines and narrowly, regularly striate on their surface, formed of a pellicle of coaly matter as thick as a leaf of paper, fig. 2 enlarged.

The tubular form of the leaves of some *Lepidodendra* is visibly marked in this species, for it is only by considering them in that way, that we can account for the difference remarked in the relative position of the vascular bundles when the leaves are flattened, for they appear on our specimen either central or lateral or single, double, triple, according to the plan in which leaves have been compressed. This fine specimen from the roof shale of the coal of Morris was communicated by Mr. J. Even. It now belongs to the State cabinet.

LEPIDODENDRON MODULATUM, Lesqx. Geol. Rep. Penn., p. 874.

Pl. XV, fig. 1.

In the shales at Morris, by Mr. S. S. Strong. It distinctly preserves its characters, though the cicatrices are small. Found, also, in concretions at Mazon creek.

LEPIDODENDRON FORULATUM, Sp. nov.

Pl. xxiii, fig. 5 to 8.

CICATRICES distant, oval, narrower and pointed at both ends, wrinkled across; leaf scar large, central, marked with three distinct large vascular points, without medial line or appendages; corticated surface deeply undulate-wrinkled lengthwise, marked by deep, narrow, equally distant furrows, separating the cicatrices in vertical rows as in the genus *Sigillaria*. The decorticated surface, fig. 7 and 8, is regularly striate lengthwise by narrow, nearly straight wrinkles, and has its cicatrices upraised or convex-rhomboidal, split from the central point downwards, by a deep narrow line.

The peculiar furrowing of the surface of this species does not appear merely casual. A disposition of this kind has already been observed, though not quite as distinctly marked, in *Lepidodendron costatum*, Lesqx., described and figured in the second volume of this Report.

Found at St. Johns, in the roof shales of the main coal.

LEPIDODENDRON TIJOUI. Sp. nov.

Pl. xxiv, fig. 1 to 3.

CICATRICES of the cortex proportionally small, ovate, long pointed at both ends, separated by a flat irregularly wrinkled border, about one line broad; leaf scar large, placed above the middle, smooth, marked by its three vascular points, without medial line or appendages; cicatrices of the decorticated surface of the same form, smooth, merely marked in the middle by a vertical line, fig. 3, (3*b* enlarged). A small piece, fig. 2, of the same, though taken from the largest part of the tree, preserves the form and distance of the cicatrices as in the specimen of fig. 1. The coat of coaly matter covering the surface is thin, smooth, and the place of the leaf scars is hardly indicated on it.

The specimens of this species were found in connection with the *Lepdiophloyos auriculatum* and its *Lepidophyllum*, as seen in fig. 1, in the roof shales of the main coal of St. Johns. Dedicated to Mr. Thos. Tijou, superintendent of the coal mining company, Duquoin.

LEPIDODENDRON MAMMILLATUM, Sp. nov.

Pl. xxv, fig 1.

GENERAL cicatrices marked obscurely by an irregular narrow furrow, obtuse at the upper end, narrowed downwards into a caudate curved point, central scar round, mammillate or convex, notched at the top, or with irregularly undulate borders. The specimen represents the decorticated part of the species, and does not indicate any trace of leaf scar or of vascular points. The surface is deeply and irregularly grooved, the grooves passing in undulations between the cicatrices.

Found in large specimens on the roof shales of the coal at Morris.

From specimens obtained two late for the plate, the species shows the character of a true *Lepidodendron*. The cicatrices are broadly oval, pointed at both ends, the leaf scar is of an oval form, enlarged on the sides or horizontally marked with a large medial vascular point and two lateral ones, placed at the corner of the leaf scar under which is an oval convex bolster. This bolster is the only part left of the specimens where the surface is old or eroded, as seen in our figure.

LEPIDODENDRON CRUCIATUM, Sp. nov.

Pl. xxv, fig. 2.

SURFACE furrowed by deep, irregular grooves, diverging from the scars in quincunxial direction ; cicatrices distant, deeply cut in the shale, but irregular and variable, generally oval and narrowed downwards. The supercortical layer of coaly matter is very thick, one line at least, deeply, narrowly and regularly striate, filling the depressions or hollow scars, and obliterating their forms.

The specimen from which the figure is copied, is large, and apparently represents the base of a tree whose bark has become roughened by age. The species is uncertain and not satisfactorily known.

Roof shales of the coal at Morris.

LEPIDODENDRON ? GREENII, Sp. nov.

Pl. xxvii, fig. 7 and 8.

CICATRICES distant and deeply marked, oval in outline, pointed at the top, rounded at the base, marked under the point by a round, deeply sunk leaf scar, bordered by an upraised ring, and marked by a single central vascular point, thus resembling the scar of *Syrigodendron.*

From the great distance of the cicatrices, which are placed in a quincunxial order, and from the form of the leaf scars, it is presumable that this species may belong to another genus, or that it is the type of a new one.

Found by Mr. H. A. Green, in Mercer Co., Ills.

LEPIDODENDRON RUGOSUM, Brgt. Brod., p. 85.

Little Vermilion; Dr. J. C. Winslow.

LEPIDODENDRON GRACILE, Brgt.

Veg. foss., 2, t. 15?

LEPIDODENDRON ELEGANS, Brgt.

Veg. foss., 2, t. 14?

In the roof shales of the coal of Morris and of Colchester, there is an abundance of small stems or branches of a *Lepidodendron* covered with short, linear, lanceolate-pointed, flat leaves, referable, from the figures given by the author, to the above-named species. These are considered by more recent authors as identical with *Lepidodendron abovatum*, Sternb., the form of the cicatrices being alike, and differing merely in size. *Lepidodendron abovatum* is also found at Morris and Colchester with large cicatrices.

GENUS ULODENDRON, Rhode.

Beitr., Pl. 3, fig. 1, Endl. Gen., p. 70.

STEM arborescent, simple, ? covered with rhomboidal cicatrices, remains of deciduous, strobile-like branches, densely covered with imbricate leaves.

This description, translated from Unger's Genera, p. 262, does not give a clear idea of the form and nature of the trees referable to this genus, for the good reason that now, after years of research among the remains of fossil plants, these species are known to us by mere detached fragments, whose relation is uncertain. Prof. Brongniart has considered this genus as merely representing species of *Lepidodendron*, and this opinion has been more or less generally admitted by others. And truly, the bark of the trees or of the species referred to this genus, bear cicatrices or bolsters generally of the same type as those of the true *Lepidodendron*, with also the leaf scars and vascular points of the same kind and placed in the same position.

They differ essentially in this: that they have two or more parallel rows of large round or oval scars, which appear as if they had been made by the base of large strobiles or cones, thickly covered with scales or short leaves. These organs have not yet been found in connection with trunks or branches, and therefore their origin is hypothetical. They have been considered either as the cicatrices of a peculiar kind of leaves, a supposition which is not admissible, or as the scars of lateral abortive or adventive branches, a supposition also unsustainable for vegetables regularly dichotomous, like those of the genus *Lepidodendron*, or as the scars of large strobiles like those of our *Lepidostrobus princeps*, (this Report, vol. ii, pl. 45, fig. 1) whose size corresponds with that of the cicatrices, and prevents the idea that they may be borne at the top of the slender branches of *Lepidodendron.*

I consider this last supposition as the right one. These scars, one or two inches in diameter, are placed in parallel rows, alternate or opposite to each other, at a distance varying vertically from two to eight inches. It is possible that these organs were borne on peculiar fruit-bearing branches of species of *Lepidodendron.* The horizontal distance between them is not great: 2 to 3 inches. What seems also to indicate *branches* is the small size of the cicatrices of the bark, which in all our specimens is about the same. There is, nevertheless, a peculiar character remarked on the specimens of all our American species, which is not observable on the bark of species of *Lepidodendron.* Their surface is ribbed lengthwise by irregular ridges, from one-fourth to one-half of an inch broad, one to two lines thick, generally angular at the top, bearing between them flattened furrows, or strips of true bark with its cicatrices. The irregularity of these ridges, which vary in size as well as in their respective distances, being sometimes close to each other, sometimes a few inches apart, contradict the supposition that they are a kind of organism resulting from the normal growth of the trees. They are mere excrescences, similar to those which are seen on old trees; for in some places, by the expansion of their borders they cover part of the scars, in some others they push them aside, as from the enlarging border of a split. When supercorticated, the surface of the species of this genus between the top of the ribs, is filled by a coat of carbonaceous matter, half a line to one line or more in thickness, in such a way that the surface of the coat of coal is on a plane with the ridges, and that consequently, the coal is thicker in proportion to the depth of the grooves, as seen, pl. xxiii, fig. 1.

The surface of this coaly matter is smooth, striate lengthwise by narrow parallel lines, and the position of the cicatrices of the bark and of the leaf scars is merely indicated by a slight depression, with a point in the middle. The peculiar nature, or rather the mode of formation of this supercortical coat of coal, which covers the surface of the plants now examined, as also of most of the species of trees found in the shales and in the sandstone of the Coal Measures, is not explained. It is evident from what is seen on our specimens, that it does not represent a true cortex, but that it is rather produced by some exudation of matter (ulmic acid ?) forced, by compression, during the process of maceration and carbonization of the plants. This supposition, however, does not account for the peculiar marks left and defined upon the surface of this matter, and different in each species.

ULODENDRON MAJUS, Ll. and Hutt.

Foss. flora., i, p. 22, t. s.

Sigillaria Menardi, Lesqx.

Ill. Geol. Rep , vol. ii, p. 450, Pl. 48.

Large and numerous specimens of this species, obtained from the shales at Morris, have afforded opportunity of studying it under various appearances, and of recognizing its identity with the species described and figured by Lindley and by Sternberg. Though the cicatrices are most of the time obliterated, and their outline modified, some specimens present them in their primitive forms, with the essential characters, the three-pointed leaf scar of the genus *Lepidodendron.*

They are rhomboidal in outline, pointed or truncate at the top, rounded at the base, enlarged on the obtusely pointed sides, marked in the middle by a slightly inflated bolster, and topped by a small rhomboidal leaf scar, marked with three vascular points. The details characterizing this species, and which have not been given by the authors, are represented in our plate 22, fig. 4. The outline of the cicatrices differs indeed from that of the known species of *Lepidodendron*, and when the surface is somewhat erased, as in the part represented fig. 4*b*, and as is generally the case on specimens of this species, it is undistinguishable from that of *Sigillaria Menardi*, Brgt.

In its decorticated state the species equally preserves the appearance of a *Sigillaria*, its wrinkled surface being marked by mere semilunar, inflated dots, as seen in fig. 4. The strobile scars are proportionally large, approximated to each other, alternating in two vertical rows, nearly exactly round, or rather enlarged horizontally.

Mr. Jos. Even, of Morris, has kindly sent photographic plates of large specimens of his, which bear these strobile scars, one and a-half inches in diameter, at a horizontal distance of three inches, and only one and a-half inches from each other in vertical direction. The vertical distance of these scars is apparently variable; it is, however, generally shorter in this species than in the following ones.

On shales at Morris and Colchester.

ULODENDRON ELLIPTICUM, Sternb.

Pl. xxii, fig. 3, and Pl. xxiii, fig. 1 to 3.

Under the name of *Lepidodendron ornatissimum*, Prof. Brongniart has represented in his Foss. Flor., vol. 2, pl. 18, a large specimen of this species. As there is not as yet a detailed description of it, and as the cicatrices of the surface are not as clearly defined on the European specimens as on ours, I have figured the essential parts of this species as exemplifications of its general appearance.

The surface cicatrices are almost exactly rhomboidal, angular on the sides, slightly elongated, more or less distant, with the leaf scar nearly central, marked in the middle by a depression or small hollow, as indicating the place of a single vascular scar. These scars are not indicated by any of the European authors. It is probable that the two lateral ones are obliterated, but, although a great number of specimens were carefully examined, they could not be detected on any one of them. Pl. 23, fig. 3 enlarged, shows the details of the forms of these cicatrices.

The strobile scars on this species are opposite to each other, vertically more distant than in the former, or four to six inches, and horizontally six inches.

On the largest of my specimens, the scars are two and a-half inches long and one and three-fourth inches broad. Some of these scars are distinctly marked by the cicatrices of the surface nearly to the middle, or just to the point of attachment of the strobile, which has only one-third of an inch diameter. This clearly indicates that the growth of the leaves was stopped around the pedicel of the cones by the compression of their open scales, and that the cone itself was attached to the tree by a pedicel as small as is generally the central axis of a *Lepidostrobus*.

Collected in splendid specimens from Morris, by Mr. S. S. Strong.

ULODENDRON ELONGATUM, Sp. nov.

Pl. xxiii, fig. 4.

THE cicatrices of the surface are in this species about of the same form as those of *Lepidodendron rimosum*, Stern., or of *Lepidodendron simplex*, Lesqx., as represented vol. 2, pl. 45, fig. 5, ofthis Report. They differ only by a narrow, elevated round border, which, as they are slightly apart from each other, leaves between them a narrow smooth furrow. The leaf scar is nearly central, as marked on the figure, and shows the three vascular points of a *Lepidodendron*. The strobile-scars are proportionally longer and narrower than in the former species, nearly twice as long as broad, vertically distant eight inches or more.

As I have not seen any specimens with double rows of these scars, I do not know at what distance they are placed horizontally, and whether they are alternate or opposite. From the form of its cicatrices, this species might be identical with our *Lepidodendron simplex*, and the strobile scars represent the base of a cone like *Lepidostrobus princeps*, Lesqx., loc. cit. Both species also may be referable to *Lepidodendron rimosum*, Sternb., and *Lepidostrobus variabilis*, Ll. and Hutt., which Prof. Geinitz, in his Verst., p. 35, describes as the same. It is only remarkable that this celebrated author persists in considering these enormous cones as sustained at the end of small branches which, according to his description, are only one-third of an inch in thickness, and that he admits the round scars of cones as mere branch scars. He has only figured one of them, however, in his tab. 3, fig. 16. It appears to represent the three different forms of *Ulodendron majus*, under the name of *Halonia punctata*, Ll.

ULODENDRON PUNCTATUM, Sternb. Vers. 2, p. 186.

Tab. 45, fig. 1, a-e.

I refer to this species, though with some doubt, a beautiful and well preserved specimen, lately communicated by Mr. John Collet, from the Mahoning sandstone? of Clinton, Vermilion county, Ind., near the limits of the State of Illinois. The specimen represents a branch compressed into an oval shape and slightly arched, three and three-fourths inches broad across in its broadest diameter, two and a-half inches in the narrowest compressed part, its upper cortex marked by small, oval, convex-pointed intumescences, with a small oval, deeply concave scar at the point, placed in spiral at about one line distance from each other. The upper cortex is formed by a pellicle of ferruginous, semi-carbonaceous hard matter, no thicker than a quarter of a line. Under it the surface is marked with the same kind of cicatrices, but the top oval scars are obliterated. On both sides of the branches there are two longitudinal rows of strobile scars, one and a-half inches distant from each other, a little less than one inch broad, oval in outline, the center marked by a round cavity, from the bottom of which a small mammilla protrudes. This is surmounted by an elevated margin surrounded with round cicatrices like those of the bark. These branch or strobile scars are alternate, five on one side, three on the other, horizontally three inches distant in measuring across the upper broadest part of the branch, and six inches in measuring on the other side across the more flattened part, therefore appearing as placed in two rows on both sides and towards the superior part of the branches. The same configuration is remarked in Sternberg's figure; but here the scars are placed along the concave border of the curved branch, while in ours it is along its convex portion. The name of *punctatum* is given to the species from the points upon the branch scars, in the author's figure, the cortex being marked by broadly triangular cicatrices. A few only of the same form are perceptible at a single, small, decorticated spot near the most erased part of our specimen, under a double layer of upper cortex. It appears, therefore, that this specimen represents the same species in a better state of preservation. *Bothiodendron punctatum*, Ll. and Hutt., 2, p. 86, has the same cortical cicatrices as ours, but differs by its long and more distant strobile scars.

Morris, on shales.

GENUS LEPIDOPHLOIOS, Sternb.

Ill. Geol. Rep., vol. ii, p. 457.

LEPIDOPHLOIOS? AURICULATUM, Sp. nov.

Pl. xxx, fig 1.

STEM or cone covered with large thick rhomboidal imbricated scales, broader than long, rounded at the sides, marked at the top by enlarged rhomboidal cicatrices and three obscure vascular points.

The specimen copied in our figure looks like a part of a large flattened cone, whose broad thick rhomboidal scales are imbricated like those of a strobile of pine, and in the same order. According to Prof. Goldenberg, specimens of this kind should merely represent the surface part of stems (*Lepidophloios*), whose leaves are attached at the base of the scales which cover them. If this is the case, it is doubtful, indeed, whether our plant is referable to this genus, notwithstanding the similarity of the scales to those of some species of European *Lepidophloios*, or whether it should be considered as a cone or *Lepidostrobus*. It is evident that the scales, which are often found isolated and variously grouped on the shales, were free to their base; that in their union, as in the specimen which is figured here, they rather represent the form of a strobile than that of a stem, and that also some of these scales appear connected with *Lepidophyllum auriculatum*, Lesqx., though the mode of connection is not distinct. On the other side these scales are marked at the top by three vascular points like the scales of *Lepidophloios*, and also have in the middle the small scar scarcely perceptible with the naked eye, which Mr. Goldenberg considers as the scar of a spine, and which also is a character of the genus. They are, moreover, remarkably similar in form to those of *Lepidophloios laricinus*, Sternb., as figured by Goldenberg in his Flor. Sarr., pl. 16, fig. 1. Though this may be its true generic relation, this species differs from the European one by the scales, which in ours are proportionally broader and shorter, and by the small medial scar which is triangular and not round.

Found in the shales of the coal of St. Johns.

LEPIDOPHLOIOS LARICINUS, Sternb.

Vers. 1, p. 28, Pl. 11, fig. 2, 3, 4.

It is not rare in the shales of the coal at Morris, in good, well characterized specimens.

LEPIDOPHLOIOS PROTUBERANS, Sp. nov.

Pl. xxvi, fig. 1 and 2.

STEM arborescent with cicatrices somewhat distant, separated by thin, undulating, continuous wrinkles bordering the cauda; cicatrices double; the upper part or leaf scar is rounded upwards and downwards, obtusely acute on both enlarged sides, marked by three vascular points, the middle of which is capped by a small, half round dot; the lower part like a broadly oval-rhomboidal wing, has both sides curving downwards as a prolongation of the borders of the leaf scar, and abruptly bent into a long pointed cauda, fig. 2. The wing is marked above the middle and under the leaf scar by a semi-lunar upraised scar. The cicatrices are generally deeply immersed in the stone, and their outlines rarely discernible. They are often covered with a coat of thick carbonaceous matter, and their center marked by a prominent nose-like gibbosity.

In the shales at Morris; collected by Mr. S. S. Strong.

GENUS LEPIDOSTROBUS, Brgt.

Ills. Geol. Rep., vol. ii, p. 455.

LEPIDOSTROBUS (species).

Pl. xxx, fig. 4 to 7.

THE figures represent in detail a specimen of a cone of *Lepidodendron* in concretions, which has its sporanges and spores still preserved in their primitive position. The form of the blades and of the sporange-pedicels, as they appear when isolated from the cone, is not recognizable, therefore its specific relation is uncertain.

The cone is figured as an illustration of the position of the sporange-cells on their axis, to which they are perpendicular, and also of the form of the seeds. These seeds, fig. 6 and 7, highly magnified, resembling those of a *Lycopodium*, are exactly three one-hundredths of a millimeter in size, nearly round or slightly tetrahedral, with valves discernible but without borders, and often agglomerated by triplication, but separating easily. The absence of borders or wings on these seeds indicates their maturity. They are easily detached from the sporanges, like a brownish powder. The part seen at the top of the cone, and represented enlarged in fig. 5, seems to be the support or the pedicel of a blade or the scale of the sporange.

In a concretion from Mazon creek.

LEPIDOSTROBUS OVATIFOLIUS, Sp. nov.

Pl. xxx, fig 2 and 2*b*.

CONE about three inches long, one inch broad, with short, erect blades; blade obtuse at its base, lanceolate obtusely pointed, comparatively broad; pedicel of the sporanges short, lanceolate. The axis of the cone appears to be narrow, a peculiarity which does not agree with the shortness of the pedicel of the sporange. As the detached blade, fig. 2 *b*, is copied from another specimen which is crushed, and whose form is unrecognizable, it may belong to a different species.

In concretions from Mazon creek.

LEPIDOSTROBUS OBLONGIFOLIUS, Sp. nov.

Pl. xxx, fig. 3 and 3*b*.

A VERY fine specimen, also from the concretions of Mazon creek, representing an exact cross section of a cone. The central axis is one line broad, the blade one inch long, its breadth one-third of the length, oblong, obtusely pointed, squarely cut at the base, and without auricles; pedicel of the sporange narrow, lanceolate pointed, one-fourth of an inch long. In its length it corresponds exactly to the distance between the border of the axis and that of the line of circumference of the cone. The sporanges are obscurely marked on the stone, mixed with pyrites, but I could not detect any spores.

LEPIDOSTROBUS LANCIFOLIUS, Sp. nov.

Pl. xxxi, fig. 7.

A SMALL, apparently narrow cone. The pedicel of the sporanges, fig. 7*b*, is very short, broadly wedge-shaped, obtusely truncate at its base; blade one inch long, slightly enlarged in the middle, tapering into an acute point, with slightly diverging acute auricle at the base; medial nerve sharply marked.

On a concretion from Mazon creek.

LEPIDOSTROBUS TRUNCATUS, Sp. nov.

Pl. xxxi, fig. 5.

CONE less than one inch long, round ovate, obtuse, truncate at the base, with densely imbricated, short, lanceolate *sphorophyllæ* (blades). None of these can be distinctly seen, being compressed against the cone.

In a concretion from Mazon creek.

LEPIDOSTROBUS CONNIVENS, Sp. nov.

Pl. xxxi, fig. 6.

CONE small, ovate obtuse, of the same size as the former, with long, narrow, linear lanceolate *sporophyllæ;* blade as long as the cone, curved at its top and covering it.

In this species, also, the pedicel of the sporanges is unknown. Both these small cones resemble in size and somewhat in form *Lepidostrobus gemmiformis*, Gopp., Permian flora, p. 142, pl. xix, fig. 14, 15, 16; but are evidently distinct species.

From Mazon creek, in concretions.

LEPIDOSTROBUS ORNATUS, Brgt.

Ll. and Hutt, Foss. Fl. 3, Pl. 26.

A broken specimen of a cone of this species has been discovered by Mr. Jos. Even, in a nodule from Mazon creek. It is cut across near its base, and the form and position of the sporanges and of the pedicels are distinctly observable.

GENUS LEPIDOPHYLLUM, Brgt.

Ill. Geol. Rept., vol. ii, p. 456.

LEPIDOPHYLLUM ROSTELLATUM, Sp. nov.

Pl. xxxi, fig 8.

A LARGE blade, broken in the middle, four-fifths of an inch broad, with a triple medial nerve, round, attenuated at the base or strangled at its point of union to the pedicel; pedicel of the sporanges half an inch long, rounded at its enlarged sides, and narrowed to an acute, slightly curved point. The collum between the blade and the pedicel is long and narrow, giving to this species a peculiar appearance.

Mazon creek; in concretions.

LEPIDOPHYLLUM STRIATUM, Sp. nov.

Pl. xxxi, fig. 9.

THE specimen shows two blades and curved pedicels of sporanges. The blades, broken at the point and along the borders, are about half an inch broad, two inches and a half long, lanceolate, slightly enlarged above the middle, marked with one narrow medial nerve, and striated in the length with well marked parallel regular lines, nearly as strong as the medial nerve. The pedicels of the sporanges are still curved as in their normal position on the strobile, and appear linear.

This species is distinct from every other kind published, by its striated blade.

Also from Mazon creek; in concretions of clay iron ore.

LEPIDOPHYLLUM FOLIACEUM, Sp. nov.

Pl. xxxi, fig. 10.

THIS leaf or blade has a form totally at variance with any other seen in the Coal Measures, and it is doubtful whether it represents a kind of vegetable organ, like those described under this generic name. It is marked in the middle by an inflated body (medial nerve?) one-tenth of an inch broad, which, at its base, is abruptly curved on one side like a sporange pedicel of *Lepidophyllum* at its point of union with the blade. This medial nerve,? slightly enlarging upwards, abruptly terminates at some distance under the obtuse point of the blade. The whole leaf is a little more than one inch long, half an inch broad, oblong-ovate in outline, cut or truncate at the base, with a small round lobe on one side of it, and split at the top in two or three deep, narrow, obtuse lobes Its surface is smooth, covered all over by a pellicle of coaly matter; the medial broad nerve only is naked and obscurely striate in its length.

On a piece of shale from the main coal of Murphysborough.

I have lately received from Mr. S. S. Strong, and from the shales of Morris, another specimen of this species, representing an agglomeration of three leaves of the same kind and form as the one above described. The point and mode of connection of these leaves is not distinguishable, though they appear to be imbricated around a common axis.

GENUS KNORRIA, Sternb. and Gopp.

Cicatrices half cylindrical, obtuse at the point, more or less enlarged downwards, like those which are indicated as the essential character of this genus, have been recognized as subcortical scars of some species of *Lepidodendron* by Prof. Goppert and other recent authors. We have seen the same also in our *Lepidodendron Morrisianum*, and in this Report still a specimen referable to *Sigillaria monostigma*, Lesqx., is figured, and bears the caudal intumescence of a *Knorria*. We have, therefore, abstained from describing any new species as referable to this genus, though we have in our Coal Measures the two species admitted to it by Goldenberg: *Knorria imbricata*, Sternb., mentioned in vol. ii, of this Report, and *Knorria Selloni*, Sternb., Vers., i, iv., p. 37, pl. 57, from the shales at Morris.

GENUS SIGILLARIA, Brgt.

Ill. Geol. Rep., ii, p. 448.

SIGILLARIA CORRUGATA, Sp. nov.

Pl. xxiv, fig. 4, and Pl. xxv, fig. 5.

CORTEX very rugose or deeply wrinkled in the length, marked by linear-oval, elongated cicatrices, gibbous in the middle and cut by a round angular scar, as seen pl. xxv, fig. 5. Lower surface also wrinkled lengthwise with smooth, shallow striæ, marked by cicatrices, oval in outline or somewhat pointed at the top, rounded in its lower part, marked in the middle by three irregular, vascular scars, placed in the shape of a horse-shoe, or by a semi-lunar scar which points downwards, and a mere vascular point underneath. These cicatrices are one inch long, half an inch broad, distant, and placed in quaternate order.

This species resembles a *Lepidodendron*, appearing related to *L. punctatum*, Sternb., which Prof. Brongniart considers a *Sigillaria*. Its leaf scars have more analogy to those of the last genus.

Found at Marseilles, LaSalle Co., at the base of the thick bank of sandstone which there appears to take the place of the lower coal strata, and which generally contains remains of large species of plants, rarely in a good state of preservation.

SIGILLARIA MASSILIENSIS, Sp. nov.

Pl. xxv, fig. 3 and 4.

STEM ribbed, ribs flat, half an inch broad, with intermediate, deep, sharply cut furrows; surface striated lengthwise by distinct, nearly continuous lines, scarcely flexuous on the borders of the cicatrices; cicatrices larger, one-third of an inch long, not quite as broad or half as broad as the ribs, rhomboidal, rounded at the top, enlarged downwards to the angular sides, obtusely pointed at the base, minutely, obscurely striate on the surface; vascular scars three, the lateral ones semi-lunar, caudate, vertical; the medial one horizontal, large, oval. The cicatrices are separated from each other by a space equal to their length. The form of the decorticated cicatrices is not known.

This fine species is allied to *Sigillaria intermedia*, Brgt., differing in its proportionally larger cicatrices, and by the regular striation of the ribs, without cross wrinkles at the base of the cicatrices, and by their angular base.

In the sandstone at Marseilles.

SIGILLARIA MONOSTIGMA, Lesqx.

Pl. xxvi, fig 5.

This species is referred, with some doubt, to the one published in vol. ii of this Report, p. 449, pl. 42. It represents a part of a trunk or branch, four inches broad, flattened to one-half an inch in thickness, marked all around in the general quincunxial order by broadly rhomboidal scars, with a round point in the middle, exactly of the same form as those of the cortex of *Sigillaria monostigma*, and at the same comparative distance. These scars are placed at the top of an inflated lanceolate cauda, three-fourths of an inch long. This kind of half cylindrical appendage attached to the specimen evidently under the cortex, gives to this species the character of a *Knorria*. If, as Prof. W. P. Shimper will have it, in his *Vegetaux fossiles du terrain de Transition des Vosges*, p. 33, *Knorria*, as a genus, differs essentially from *Lepidodendron* by the cicatrices having a single central vascular scar, our species should be considered as a true *Knorria*. But the same author denies the existence of any specimen showing, at the same time, the character of *Lepidodendron*, or the three vascular scars of the leaves and the semi-cylindrical and subcortical appendages of a *Knorria*. These we have evidently in our *Lepidodendron Morisianum*. The value, therefore, of the genus *Knorria*, and its true characters, are still questionable and open to discussion.

Colchester and Morris.

SIGILLARIA ALTERNANS, Ll. and Hutt.

Foss. Fl. 1, pl. 56.

A remarkable specimen of this species has been found upon a piece of coal at Morris, by Mr. S. S. Strong. In its lower part it shows the row of double scars separated by a space of half an inch, elongated and irregularly oval. In ascending, the scars approach insensibly till they pass to a row of single ovate pointed cicatrices, joined together by their ends with an oval depression in the middle. This last representation of *Sigillaria alternans*, Ll. and Hutt., is exactly *Sigillaria catenulata* of the same authors, Foss. Flor. 1, pl. 58, and therefore both species ought to be united in one, as is done by Goldenberg.

SIGILLARIA SPINULOSA, Germ. in Gold. 2.

P. 20, Pl. 10, fig. 4.

Our species merely differs by the lateral angles of the cicatrices being slightly obtuse and not acute, as figured and described in the European species. There is no trace of scars of spines. It may be a different and a new species, but it is on a piece of coal, decorticated, and all the details of structure cannot be recognized.

Carmi, White county; collected by E. T. Cox.

SIGILLARIA CISTII, Brgt.

Veg. Foss. 1, p. 418, Pl. 140, fig. 2.

This species is placed in the genus *Stemmatopteris* by Corda, and appears to be a true *Caulopteris*. Mr. Bradley has found at Morris a specimen referable to this species; but it has only one scar, and from it to the base of the specimen, there is a surface half a foot long, without trace of any other scar. The whole surface is ribbed or striated as in Brongniart's figure, the striæ curving and uniting under the scars.

GENUS SYRINGODENDRON, Sternb. and Brgt.

Ill. Geol. Report, vol. ii, p. 451.

SYRINGODENDRON PES-CAPREOLI, Sternb.

Vers. 1, 4 ; p. 24.

In shales at Grayville; collected by E. T. Cox.

SYRINGODENDRON PORTERI, Sp. nov.

Pl. xxvii, fig. 4 to 6.

STEM round and thick. (The State cabinet at Springfield has a branch four inches in diameter, and another double this thickness.) Surface covered with scars placed close to each other in vertical rows, no more than one-sixth of an inch distant, the horizontal space between the rows double as large, filled with vertical parallel and continuous lines or narrow wrinkles close to each other. Scars small, scarcely one-twelfth of an inch across, round, marked in the middle by a vascular depression, overtopped by a convex or semi-lunar deep cavity, which gives to the scars the appearance of an open eye, fig. 6. This line either divides the round scar at its top, or passes a little above it. These scars have the form of those on *Syringodendron cyclostigma*, Brgt., and the striæ of the surface are also of the same kind in both species.

But this species greatly differs by its closely approached scars, and especially by the absence of the intermediate furrows. This character might even prevent the admission of the species into this genus. If, as I am informed, there is a specimen (which I have not seen), found in connection with those examined for this description, and which is abruptly strangulated and reduced to half its diameter, a form indicating a root rather than a branch, this species should be admitted into the following genus.

Found at Eugene, Ind., and presented to the State cabinet by Mr. Isaac Porter.

SYRINGODENDRON CYCLOSTIGMA, Brgt.

Hist. Veg. Foss, p. 480, Pl. 166, fig. 2 and 3.

Found at Alton, by Mr. H. A. Green.

GENUS SIGILLARIOIDES, Lesqx.

CYLINDRICAL roots or stems ? variable in size, marked on the surface either by round scars, without trace of a central vascular point, placed in a regular quincunxial or spiral order, or by defined *Sigillarioid* cicatrices with a central vascular point, without any regular order of position in relation to each other. To this genus are referable the remains of what I consider as roots of *Sigillaria.*

SIGILLARIOIDES RADICANS, Sp. nov.

Pl. xxxi, fig. 4.

PRIMARY axis cylindrical, about one inch broad, irregularly inflated and strangulated towards the narrower base, bearing long tubular rootlets or leaves attached to rhomboidal cicatrices, which are narrowed on both acute sides, and marked in the middle by a broad vascular point; leaves or rootlets more than one line broad, marked in the middle by a vascular line or medial nerve. The scars are tolerably distant, and without any regularity of position relatively to each other. Though slightly variable in their form, they are so remarkably similar to those of *Sigillaria monostigma,* that the intimate relation of these remains cannot well be doubted. This specimen is interesting, especially as seemingly indicating a similarity of scars between some species of trees of the Coal Measures and their roots.

Mazon creek; in clay iron-stone nodules.

SIGILLARIOIDES STELLARIS, Sp. nov.

Pl. xxix, fig. 8.

STEM cylindrical, half a foot in diameter, irregularly inflated and contracted, obliquely crossing the shale, marked on its surface by small, round, slightly angular, sometimes nearly square or triangular cicatrices, in exact quincunxial order. These are slightly upraised above the surface, truncate, without trace of vascular point. Surface obscurely wrinkled between the scars, with lines diverging starlike toward the nearest cicatrices.

This beautiful specimen, figured half its size, evidently represents part of a root of a large *Sigillaria*. Its oblique position in the shale is marked by the upper and lower flattened surface, to which the direction of the stem is at an angle of thirty degrees. The inflation and contraction of the cylinder, which is irregularly strangulated, indicates also a tree's root. The scars placed in regular order, though double the size marked in the figure, are much smaller than cicatrices of *Stigmaria*. In the strangulated part of the cylinder, some of these cicatrices are deeply immersed in the stone, and do not show, any more than those which are slightly upraised above the surface, any trace of a mammilla or central point. The wrinkles of the surface and their direction resemble those of *Stigmaria anabathra* var. *stellaris*, Gopp.

Found in the roof shale of the coal at Morris; by Mr. Jos. Even.

GENUS HALONIA, Ll. and Hutt.

Foss. Flor. 2, p. 12.

THIS genus represents aborescent stems bearing two kinds of cicatrices; small ones, like round or rhomboidal points closely approached, disposed in regular spiral order around the stem; large ones more distant, upraised like half round, obtuse tubercles, disposed about in quincunxial order.

HALONIA TUBERCULATA ? Brgt.

Pl. xxix, fig 1.

STEM about three inches broad, flattened by compression to one inch, bearing large, round, elevated tubercles, hollow in the middle, or funnel-shaped, with a round convex point or small mammilla in the center. The specimen is not only decorticated, but corroded by sulphuric acid, and nothing is seen of the cicatrices between the tubercles but irregular, undulate wrinkles, crossing each other without any definite direction. The hollow tubercles look like large cicatrices of *Stigmaria.*

As the tubercles of the species of *Halonia* have never been described *hollow* in the center, our plant is doubtfully referred to it. The deterioration of the surface has evidently not produced the cavities of the tubercles, for the internal surface is smooth, regularly inclined downwards, bearing at the bottom a discernible vascular scar, similar to that of a *Stigmaria.* This species may be a *Stigmaria,* though the cicatrices are at least double of those of *S. umbonata,* Lesqx.

From the Chester group, Pope county.

GENUS STIGMARIA, Brgt.

Ill. Geol. Rep., vol. ii, p. 447.

STIGMARIA ELLIPTICA, Sp. nov.

Pl. xxix, fig. 2.

STEM thick, half a foot broad, flattened to one inch; cicatrices placed in regular spiral quaternate order, elliptical, more or less elongated and proportionally narrow, with a central nearly round, small mammilla, marked in the middle by a vascular point. The specimen is covered with a thin coat of coaly matter, which has filled the scars, where it has an increased thickness, obliterating generally the mammillæ. These are, however, distinguishable at the bottom of some cicatrices. Their size is proportionally small. The species is perhaps referable to some of the numerous varieties ascribed by authors to *Stigmaria ficoides.*

Prof. Goppert (*Flora des Ubergangsgebirges*, p. 246, pl. xxxii, fig. 3,) has published as *S. ficoides* var. *elliptica*, a specimen apparently decorticated, with oblong, elliptical and unequal cicatrices. These, by their irregularity of form, size and position, evidently belong to a species different from ours. The same author, in his *Gattungen Liv* .1, 2, pl. xv, fig. 49, shows part of the stem of a *Stigmaria ficoides*, whose cicatrices, taken from within the cylinder, are elliptical, while those of the surface are round. But in the specimen here figured we have the true cicatrices of the cortex. I do not think it advisable to enumerate and describe the different forms of *Stigmaria* as mere varieties of the same species. The vegetable remains described in the next genus, demonstrate that even the roots of plants of the Carboniferous age are distinguishable by peculiar forms and peculiar cicatrices. It is my belief, the genus *Stigmaria* does not represent tree roots, but floating stems, of which species of the genus *Sigillaria* constitute the flowers or fruit-bearing stems; the difference in the form, the size, and the relative position of the scars ought to be admitted as specific characters in the same manner as for the species of the genus *Sigillaria.*

Duquoin; shales over the main coal.

STIGMARIA UMBONATA, Lesqx.

Geol. Rept. of Penn., p. 870.

I refer to this species remains of a *Stigmaria* found in abundance in the shales of the coal at Colchester, where the leaves are seen in connection with the stems. The cicatrices of the stems are of much larger size than those of *Stigmaria ficoides*, and the flattened leaves are twice as broad, measuring half an inch or more in diameter.

GENUS STIGMARIOIDES, Lesqx.

THE species referable to this genus, very variable in form, tuberculose, or globular, or cylindrical, are apparently tree roots or *rhizomas.* They have, as common characters, round, small scars of rootlets, generally placed without symmetrical order, and without a central vascular point.

The affinity of this genus with the former appears at first very close ; but we have here species, evidently roots, some of them rhizomas of ferns, marked by irregularly placed scars, which cannot be united to a genus which, even if it should represent a kind of roots, is far different in its essential characters, viz : the regularity of position and the form of the scars. The name of *Rhizolites*, P. Braun., a genus enumerated but not described by Unger, might be, therefore, appropriate if, per contra, the species had not a near relation to those of the former genus, by the form of the cicatrices and of the leaves.

All these species appear to have been of a soft substance, and without exception, have been found preserved in nodules.

STIGMARIOIDES TRUNCATUS, Sp. nov.

Pl. xxix, fig. 4.

A cylindrical root, about one inch in diameter, with a smooth surface, marked with small round cicatrices, without order of position. These cicatrices vary much in size, and are evidently scars, left at the base of short, horizontal, flat rootlets, scarcely one line broad, without mark of a vascular line. The vascular point is also absent in the middle of the scars, or marked by a mere cavity.

This species resembles the one published in vol. ii of this Report, p. 448, pl. xxxix, fig. 9, under the name of *Stigmaria Evenii*, which has the surface undulately ribbed and broader scars, and is also referable to this new genus.

Found at Mazon creek, in concretions of argillaceous iron ore.

STIGMARIOIDES TUBEROSUS, Sp. nov.

Pl. xxix, fig. 5.

I do not know any vegetable organ to which these peculiar remains could be compared. The specimen figured represents a nearly round or square oval tubercle, with a convex surface covered with small round points irregularly placed, resembling scars of hairs or scales. In its upper part it is strangulated or narrowed into a broad, tubulous, plaited leaf? or stem? resembling a large leaf of *Stigmaria*. It may indicate the first development of a rootstock, or represent a tubercle like those found at the end of the leaves of *Stigmaria*. It is marked in its upper part by a large round mammillate cicatrice, resembling also that of a *Stigmaria*. Its peculiar form cannot be considered as some casual deformation, as it is not only distinct in the middle of a concretion, but we have two specimens of exactly the same conformation. The one which is not figured has the leaf longer, and the tuberule slightly smaller.

From Mazon creek.

STIGMARIOIDES VILLOSUS, Sp. nov.

Pl xxxi, fig. 1.

THE form of this kind of tubercle is about the same as that of the former species, square, round in outline, appearing to have been cylindrical or inflated. Its surface is marked by two kinds of cicatrices: the one, numerous, punctiform, inflated, placed close to each other in irregular spiral order; the other much larger, auricular, with a mammilla and central point. The first look like scars of scales, the others like those of rootlets. This tubercle is, as seen on the figure, in close connection with a branch of *Pecopteris villosa*, Brgt.

But the union of both parts is not evident, for at its base the rachis is straight, and not curved to the root, by which the juxtaposition may be casual. Nevertheless the verrucose surface of the tubercle resemble so much that of the stem of the *Pecopteris villosa*, that it is scarcely hazardous to consider it as part of the rhizoma of this fern, and the same familiar juxtaposition of the same species of fern and the tubercle is marked upon the three specimens, which are all that have been procured as yet of this peculiar form.

Found at Mazon creek, in concretions of argillaceous iron ore.

STIGMARIOIDES LINEARIS, Sp. nov.

Pl. xxxi, fig. 2.

A long, linear, cylindrical root, half an inch thick, slightly tapering downwards, obtuse at the base or broken, bearing narrow linear leaves or radicles one line broad, without medial nerve, leaving at their point of attachment small round cicatrices, placed without order and without visible central point. The rootlets or the first divisions of the root are also marked with round scars, fig. 2*a*, indicating a subdivision similar to that which is sometimes observable on leaves of *Stigmaria.*

Found at Mazon creek, in concretions.

STIGMARIOIDES AFFINIS, Sp. nov.

Pl. xxvii, fig. 9.

THIS species, represented by two specimens, appears intermediate between *S. tuberosus* and the following. It has a short cylindrical base, divided like a root in branches, tending obliquely downwards and diminishing to a point. This part, about one inch long, is covered with horizontal, half an inch long linear narrow scales, or by their scars, in the form of sharply elevated points. From its slightly strangulated *collum*, or top, it abruptly passes into a broad linear flat leaf or blade, marked on each side by two obsolete lines resembling nerves. Its surface is equally marked with distant points, basilar scars of scales, a few of which are still seen on its borders. These borders are straight, sharp, well defined, like those of a leaf of *Lepidodendron,* and the surface is minutely and irregularly striate lengthwise.

Found in the concretions of Mazon creek; by Mr. Jos. Even.

STIGMARIOIDES SELAGO, Sp. nov.

Pl. xxxi, fig. 3 and 3*b*.

AN apparently cylindrical branch or root, whose essential axis, about half an inch thick, is tapering downwards, dichotomously forking, covered with long, narrow, linear hairs or scales (fig. 3*b* enlarged), bearing from the end of the divisions long, hard, quadrangular, tubular, thick, naked leaves?, with a thick, medial, vascular vein, and a narrowly striated surface.

These leaves or roots are similar in form to those of *Lepidophloios*, but much longer. The figure exactly represents the specimen, which is finely preserved in the middle of a concretion. But the union of these hard, smooth, cylindrical leaves with a stem or root entirely covered with hairs, and from the point of alternate divisions, is so peculiar, that nothing among fossil or living vegetables, that I know, can be compared to it. It is uncertain whether these hard leaves represent rootlets of some kind, or root-stalks or leaves, and possibly the specimen may be figured the wrong way. By its straight, horizontal, narrow, linear hairs, the part of the stem which bears them resembles the species published in vol. ii, of this Report, p. 446, pl. xli, fig. 3, under the name of *Selaginites uncinnatus* (1).

In a concretion from Mazon creek.

---

(1) Under the name of *Rhizomopteris*, Prof. Schimper has published, loc. cit., p 699, two species formerly referred to *Selaginites*, one of them, *S. uncinnatus*, Lesqx., Ill. Geol. Rep., p. 446, pl. xli, fig. 3, which he considers as rhizomas of ferns. These two last species of ours should be referred to the same genera. *Phizomopteris* (*Selaginites*) *Rrdmanni*, Germ., has been found in the concretions of Mazon creek in well preserved specimens.

STEMS OF FERN TREES.

GENUS CAULOPTERIS, Ll. and Hutt.

Ill. Geol. Rep., vol. ii, p. 458.

CAULOPTERIS OBTECTA, Sp. nov.

Pl. xxviii, fig. 1 to 4.

STEMS of small size, varying in thickness from four to six inches, entirely covered with long, linear, cylindrical, ærial rootlets, attached to it without relative order of position, bearing at their base an elongated oval scar. Branch scars distant, oval obtuse at both ends, two to three inches long, one to one and a-half inches broad, marked lengthwise by broad striæ, or marks of ærial roots. The rootlets are regularly cylindrical, one foot long or more, apparently tubulose, without trace of a medial vascular line, closely appressed to each other, and upon each other in the same downward direction, and so entirely covering the stem that their cicatrices are rarely distinguishable. The branch scars are distant, as seen figs. 1 and 2, which show both sides of the same part of a stem, and indicate the relative position of the scars. The order of position appears to be as one to four, but is obscured by the flattening of the stem, whose thickness is, by compression, reduced to one inch at the upper part, and to two inches at the lower part. A branch scar and part of stem are figured, natural size, fig. 3. The distance between these branch scars is so great, especially toward the base of the stem, that a number of specimens, some as large as one foot square, were collected at Colchester, and, though closely scrutinized, did not show any trace of them.

These specimens are generally flattened to less than one inch in thickness, as if the stem had been of a soft texture. Generally the coat of superposed radicles is transformed into a pellicle of coal and these are marked on their surface by very thin parallel striæ, perceptible only with a strong glass. This coating of radicles upon the stem of a fern has nothing peculiar in it, as some fern trees of our time show the same kind of conformation. One species, *Polypodium armatum*, Swartz, from Brazil, is figured in Sternberg's Vers., vol. i, pl. E. But from the Coal Measures we have as yet nothing analagous to this species.

The beautiful stem represented, figs. 1 and 2, is from the shale of Morris, and belongs to Mr. Jos. Even, who kindly furnished me with splendid photographs of it.

CAULOPTERIS ACANTOPHORA, Sp. nov.

Pl. xxvi, fig. 3 and 4.

THE species is represented by numerous specimens, some of them of large size, all of the same appearance. Their surface, either naked or coated with a pellicle of thin coaly matter, is marked by irregular elevated points, placed without regular order, evidently the basilar scars of spines, with which the branches or stems were covered. On the large specimens no trace of branch scars was discernible, but the oval line, marked fig. 3, running parallel to a broad depression seen at the corner of the figure. It is a kind of deep convexity in the shale, with smooth, irregular borders, resembling rather the impression left by the sides of a nodule than a branch scar.

Fig. 4 represents a branch of this species, apparently at least, for it has the same kind of cicatrices exactly on the surface, and still bears on its borders some of the hooked spines by which they are produced. The branch is attenuated into a conical point of attachment which does not resemble that of a branch of *Caulopteris*, and is also marked in the middle by a scar which, per contra, has the form of the branch scars of a fern. These specimens, all flattened, are therefore probably only referable to this genus.

It abounds, like the former species, at Colchester, and is also found at Morris.

CAULOPTERIS INTERMEDIA, Sp. nov.

CICATRICES elliptical, elongated, three inches long, a little more than one inch broad, narrowed downwards into a broad cauda, pointed at the top, irregularly ribbed or sulcate, with a central, elongated scar, and without definite marginal disc. Surface between the cicatrices apparently smooth, marked by points or mammillæ about one-eighth of an inch broad, half an inch distant, placed in an irregular spiral order. The space between the cicatrices is horizontally one and a-half inches, and two inches in the direction of the spiral.

This species is known to me only by a sketch lately communicated by the State Geologist, and received after the preparation of the descriptive part of this Report, and the engraving of the plates. It appears to be intermediate between *Sigillaria Marodiscus*, Brgt., and *Sigillaria Cistii*, of the same author. The form of the cicatrices is about the same size as in the first of these species, but they are disconnected at the base, placed in true spiral order, and at some distance from each other, as in the last species. It is a true *Caulopteris*, according to Schimper's definition of the genus, while most of our species of *Caulopteris*, viz., those whose internal cicatrices are surrounded by a flattened border generally opening inwards in the form of a horse shoe, are referable to the genus *Stemmatopteris*, of Corda.

In sandstone, over coal No. 3, one mile south of Rushville, Ill.

FRUITS OR NUTLETS.

GENUS TRIGONOCARPUM, Brgt.

Ill. Geol. Rep., vol. ii, p. 460.

TRIGONOCARPUM NŒGGERATHII, Ll. and Hutt.

Pl. xxxi, fig. 16.

This fine fruit is cut in the middle by a section of a nodule which only represents its internal part and structure. As the outside form is not known, and the internal disposition is slightly different from that of the fruit published by Lindley and Hutton, vol. ii, pl. 142, our species is doubtfully considered as identical with the European one. This fruit has three distinct walls or envelopes. The external one, more than one line thick, looks like a fleshy, soft exocarp, the part which it occupies being of the same compound as that of the stone, merely changed in color and intermixed with small pyrites. Its form is exactly ovate-pointed, slightly emarginate at the point. The second wall, transformed into crystallized iron, is irregular in thickness, ascends, first as high as the point of the central rootlet, where it divides, one part uniting both borders, the other ascending near to the point where it is joined in an obtuse top. The third envelope, as thick as the first, ascends to the point *c*, and is a compound of a black substance mixed with fibrous tissue. The internal nut is of a spongious compound like the third envelope, but is marked with more numerous, yellowish filaments, directed longitudinally, and irregularly broken across. Its point seems ascending into the first wall of the whole fruit. The English authors compare the fruit to that of a palm, and recognize in the middle of it, the place of the embryo, a depression which is not seen in ours.

Found in a concretion of Mazon creek, by Mr. Jos. Even, to whom the specimen belongs.

TRIGONOCARPUM OLIVÆFORMIS, Ll. and Hutt.

Foss. Fl. 3 t. 222, fig. 1 and 3.

Collected from the sandstone of Eugene, Ind., by Mr. John Collett.

GENUS RHABDOCARPOS, Gopp. and Bergr.

Fruits oval or cylindrical oblong, marked lengthwise on their surface by narrow equal striæ.

RHABDOCARPOS CLAVATUS ?, Sternb.

Pl. xxxi, fig. 11.

Our specimen much resembles the figure given of this species by Geinitz, in Versteinerungen, pl. xxii, fig. 13, though it is much larger than the fruit figured by Sternberg. The endocarp is about round, elongated upwards in a *collum* resembling the neck of a bottle; its surface, which is somewhat convex, is a mass of coaly matter, cut across by deep wrinkles, caused by disruption; the exocarp surrounding it is about one line thick, of the same shape as the endocarp, but slightly enlarged at the point and funnel shaped. It looks of a harder texture than the internal fruit.

In a concretion from Mazon creek.

RHABDOCARPOS MAMMILLATUS, Sp. nov.

Pl. xxxi, fig. 12 to 15.

A FINE small nutlet, quite entire and separated from the stone. It is apparently of a hard texture, oval, marked on its surface by regular, distinct deep striæ, running down from the borders of a smooth mammillate top to the base, as seen fig. 14 and 15.

The surface of the nut is a thin shell which, as seen from a small part which is detached, covers a hard, smooth fruit.

From Mazon creek, in concretions.

GENUS CARPOLITHES, Sternb.

Ill. Geol. Rep., vol. ii, p. 460.

CARPOLITHES CORTICOSUS, Sp. nov.

Pl. xxxi, fig. 17.

A SMALL flattened nutlet, oval, short pointed at one end, (the point turned on one side) and covered with a thin yellowish membranaceous pellicle. It is surrounded by a proportionately thick pericarp, having the same form, and being a compound of crystallized iron.

Mason creek; in concretions.

CARPOLITHES PERSICARIA, Sp. nov.

Pl. xxxi, fig. 18.

A SMALL fruit, one-half of an inch long, only half as broad, oval elongated, pointed at one end, slightly emarginate at the other, with a thick exocarp, and an internal compound of the same form, but of a softer substance. The outer wall is preserved, while the internal part is nearly destroyed. It resembles a small kernel of a peach.

On shale found at Murphysborough; and poorly preserved.

CARPOLITHES VESICULARIS, Sp. nov.

Pl. xxxi, fig. 19 to 21.

THIS kind of fruit resembles a small bladder, which, by compression in various ways, has taken different forms. It is generally elongated, more inflated and obtuse on one side than on the other, cylindrical. Its surface is smooth, generally covered with a thin coating of coaly matter, marked with broad wrinkles and undulations, as in fig. 19. Fig. 21 shows a kind of inflation or convexity, surrounded by a flattened border, resembling an endocarp and its exocarp. This form may be merely casual.

Morris and Murphysborough; abundant in the shales over the coal.

CARPOLITHES BULLATUS, Sp. nov.

Pl. xxxi, fig. 22 to 24.

AN agglomeration of oval or round, small, wrinkled seeds, resembling vesicular spores, all nearly of the same size. Like the former, they appear to have been of a soft vesicular texture. Fig. 24 shows them enlarged.

In concretions from Mazon creek.
The surface of the stone transversely cut, is covered with them.

SIGILLARIÆ ? SEMINA, (Seeds of Sigillaria?).

Pl. xxxi, fig. 25, and 25a.

The concretions of Mazon creek contain agglomerations of small seeds, united into cylindrical-ovate clusters, about one inch long, nearly half an inch broad, obtuse at both ends, without trace of any common receptacle to which they might be attached. These seeds are rounded upwards, triangular and tapering to a point downwards, as seen in fig. 25*a*, enlarged five times. The space which contains these seeds in the middle of nodules, is filled with a calcareous, white compound, in which the yellowish brown seeds are imbedded without any apparent regular order.

On the shales at Morris, where clusters of the same kind have also been observed, the agglomerations are flattened in irregular round patches, about one inch in diameter, no more than half a line broad. Though these seeds, by their form and size, are similar to those which have been figured by Goldenberg in his Fl. Sarr., 2, pl. 10, fig. 1 and 2, as seeds of *Sigillaria*, and also to those remarked under the scales of true cones of *Sigillaria* found in Ohio by Dr. Newberry, their generic relation is still uncertain. They are evidently referable to some species of the family of the *Selagineæ*.

Collected by Mr. Jos. Even.

ORGANS OF UNCERTAIN AFFINITY.

GENUS PALÆOXYRIS, Brgt.

Ann. Sc. Nat., xv., p. 456.

SPINDLE-SHAPED strobiles, covered with closely imbricated rhomboidal scales, disposed in spiral order, the inferior ones passing to an angular pedicel, the upper ones lengthened into linear appendages.

This description is copied from Unger's genera, and though inappropriate for the classification of the species referred to it, this genus is preserved, with its diagnosis, for the good reason that, as will be seen hereafter, the true nature of these organs is unknown.

PALÆOXYRIS PRENDELI, Sp. nov.

Pl. xxvii, fig 10 and 12.

A SPINDLE or bottle-shaped body, appearing like a flattened small bladder, enlarged in the middle, tapering into a long neck, more abruptly rounded and narrowed downwards into an obtuse point, surrounded by a double line of thin but deep filaments or striæ, scarcely half a line distant, often close to each other, ascending in spiral form from the basilar point, at first in an obtuse angle with the borders, but elongating upwards and ascending into the neck where they become nearly parallel to its sides. The surface of this capsular body is formed of a thin pellicle, and by its compression, the spiral lines of both sides are marked upon it, thus forming, by their crossings, a trellis of more or less enlarged rhomboidal divisions. In ascending into the neck, the spiral lines approach more and more, nearly uniting into one. The whole surface is marked with close, very narrow lines, running in the direction of the twining, and discernible only with a strong glass. The borders are smooth or without any projections.

On the specimen represented, fig. 12, the spiral lines are erased in the middle of the body, which is there undulately and irregularly wrinkled like the outside of an empty bag. As the form, the distance, and the direction of the spiral lines from under the neck and upwards, where they are distinct, are the same, I consider this specimen as representing a modification of this species by age.

The best specimen found to the present time, of all those referable to this genus, is that represented fig. 10. It was kindly presented to me by Mr. Michael Prendel, of Morris, for whom the species is named.

It is, like all the others mentioned here below, from the concretions of Mazon creek.

PALÆOXYRIS APPENDICULATA, Sp. nov.

Pl. xxvii, fig. 11.

BODY spindle-shaped, ovate in the middle, tapering and elongated at both ends, filaments placed at about equal distances from each other, distance averaging the twelfth part of an inch, turning at the middle in a nearly horizontal spiral, descending downwards in a more acute angle, and abruptly terminating above and in ascending, in a concave straight blade, where they become parallel with its borders. On both sides, in the middle of the body, the lamina or substance intermediate to the spiral filaments, protrudes outwards forming irregularly pointed triangular teeth or appendages, which, however, are not marked at some places. This shows them to be the result of a mere mechanical lateral projection, like those which would be produced on its sides by the compression of an envelope, either formed of twisted, concave, semi-cylindrical blades, or of a soft bladder, surrounded by strong spiral fibres. Our figure may be represented in a wrong direction, or turned upside down.

PALÆOXYRIS CORRUGATA, Sp. nov.

Pl. xxvii, fig. 18.

Its form is, like that of the former, spindle-shaped, more elongated, and gradually tapering to both its ends. Its surface, irregularly folded and wrinkled, has not any trace of spiral fibres. In its upper neck, the body appears passing into parallel blades, while downwards it is bordered by two leaf-like appendages of a coriaceous substance. These linear blades are somewhat concave, the one bending downwards, the other upwards, like the remains of spiral, still half bent laminæ. The folds of the body do not show any peculiar form like the outline of a hard substance inclosed, but they are mere irregular wrinkles, like those which could be formed upon the outside of a crumpled empty bag.

From what is said in the above descriptions, it is evident that the true nature of the organs placed under this generic name is unknown. They cannot have any relation to the flower-bearing spikes of a *Xyris*, for they do not show any trace of scale-like bracts, forming a flower head, or of points of attachment of such scales; nothing that could be compared to flowers or to their receptacles. If these bodies were more regular, and appearing as though containing some nutlet, they could be compared, by the rhomboidal marks of the surface, to some fruits of palm, like those of the genus *Mauritia* or *Lepidocarpum*. But in all the vegetable organs of this kind, the disposition of the scale-like surface of the walls is far more regular than it is in ours. It is not quite evident whether the spiral lines marked on the outside are formed by the twisting of leaf-like blades, or by mere thread-like filaments. The variety in the distances between these lines, as seen fig. 10, tends to support this last supposition, while the lateral projections of the borders, in fig. 11, and the leaf-like appendages seen at the point and base of our two last species seem, on the contrary, to indicate a conformation by the spiral winding of grass-like leaves. In this case, it could be supposed that these bodies represent rhizomas of some plant like *Cordaites*, whose unfolding of the leaves is in a spiral, and which might be seen already folded in that way in the embryonic or radiculose state? After all, they may belong to the animal rather than to the vegetable kingdom, and represent envelopes formed in that shape by some kind of insects for inclosing the larvas. Their irregularity seems to dictate this conclusion. The two figures given by Count Sternberg in Vers., 2, p. 189, pl. 59, fig. 10 and 11, of *Palæoxyris Munsteri*, represent a species far different from ours; but if the figures are exact, they distinctly show that the spindle-shaped body is an envelope, formed by the twisting of three or four leaf-like blades, for at the upper and lower ends, where the twisting ceases, these blades separate, and are seen linear and parallel, each about one-eighth of an inch broad, with the same form, size and position, at both ends of the inflated body. Such a conformation seems far more the result of animal industry than of vegetable organization.

The species hitherto referred to this genus, are, with the first-named: *P. Munsteri*, of Sternb., *Palæoxyris regularis*, Brgt., loc. cit., which, by its regular scale-like scars, is different from ours; *Palæoxyris multiceps* and *Palæoxyris rhombea*, two species of F. Braun, merely enumerated in Unger's Genera and Spec., without description. The two last species, like that of Sternberg, are from the Keuper Lias: that of Prof. Brongniart, from the Permian. Our species, represented in the lower part of the true Coal Measures, are therefore interesting to science, from their geological position.

Mazon creek, Grundy county.

The following species have been found and communicated to me since the preparation of the plates: and have not yet been figured:

NEUROPTERIS MICROPHILLA, Brgt.

Foss. Flor., p. 245, Pl. 74, fig. 6.

Represented by two specimens from Mazon creek, which, though showing the characters marked by the author, do not distinctly indicate whether the species is truly a distinct one, or merely a small form with obscure nervation of *Neuropteris Loschii*, Brgt.

NEUROPTERIS ANGUSTI-FOLIA, Brgt.

Foss. Flor., p. 231, Pl. 64, fig. 3 and 4.

The specimen is an exact representation of Brongniart's figures of this species. The surface of the leaflet is smooth or without hairs; the veinlets somewhat coarser, and not quite as distinct as in *N. hirsuta*, are marked at the upper part of the leaf and at the base of the veinlets by the same kind of swelling or tumor which is seen in the author's species, and has been considered by him as remains of fructification. The leaf at its base is elongated on one side in a kind of auricle, and abruptly narrowed or truncate at the other, linear lanceolate, obtusely pointed with a comparatively broad pedicel one-fourth of an inch long. This last character seems to unite this species to *Neuropteris Scheuchzeri*, Brgt., which the author considers as probably identical with *Neuropteris angusti-folia*. I have lately received from Mr. S. S. Strong, and also in a concretion from Mazon creek, a splendid specimen representing the top of a pinna of *Neuropteris hirsuta*, Lesq., in the process of unfolding, or still curved in spiral, whose leaflets, very hirsute on one side only, are narrow, linear lanceolate, and unequal at base, exactly like the leaflets of *N. angusti-folia*, Brgt. I am, therefore, not yet satisfied that this last species is a distinct one, and still believe that it may represent a form of *N. hirsuta*, as it has been explained, Geol. Rept. Penn., p. 857.

Concretions of Mazon creek; from Mr. Even.

NEUROPTERIS CRENULATA, Brgt.

Foss. Flor., tab. 64, fig. 2.

I refer with doubt to this species a specimen procured by Mr. S. S. Strong from the concretions of Mazon creek. It represents the upper end of a pinna bearing oblique, oblong, obtuse leaflets, attached to the rachis by the narrowed base, forming a broad pedicel, and of the same form as those figured by Brongniart. The upper leaflets are simple, the lower ones compound, or bearing on each side at their base a round, small, cyclopteroidal pinnule. The medial nerve of the leaflets is obscurely inflated, the veins and veinlets are distant, arched, distinct, not inflated, forking once or twice; the borders are slightly crenulate by a contraction of the epidermis at the point of the veinlets. Our specimens agree well enough with some of this species obtained from Pennsylvania, as also with the description of the author. There is, nevertheless, a difference especially marked by the division of the inferior leaflets with small round pinnules at the base, like those of *Neuropteris hirsuta*, a division which has not been heretofore noticed in this species. The teeth of the borders are also less prominent and distinct on our own specimen.

CALLIPTERIS SULLIVANTII, Lesqx.

Ill. Geol. Rep., vol. ii, p. 440, Pl. 38, fig. 1.

Some specimens, in concretions from Mazon creek, show the lower divisions of the pinnæ more elongated, and pinnately cut-lobed, as in species of *Alethopteris*. This kind of subdivision would therefore indicate the place of this species in this last genus, as admitted by Schimper, Paleont. Veget., p. 561. But the peculiar nervation of this fine fossil fern, which is half neuropteroidal, has a close analogy with the species admitted by Brongniart as the type of his genus *Callipteris*. When better known it may probably indicate the character of a new genus.

ALETHOPTERIS LONGIFOLIA, Brgt.

Foss. Flor., p. 273, Pl. 83, fig. 2.

The specimen, a fine one, represents the upper part of a pinna, with a broad half round rachis, bearing alternate, horizontal, narrow, linear, simple pinnules, attached to it by their whole base, but not connate, with entire or scarcely undulate borders. The nervation is exactly as figured and described by the author. The leaflets are marked by round scars of *sori*, placed near the border, one only upon each middle vein; the details of their structure cannot be seen, but they greatly differ in form and position from those of *Alethopteris emarginata*, Gopp.

Concretions of Mazon creek; r. Even.

ALETHOPTERIS PENNSYLVANICA, Lesqx.

Penn. Geol. Rept., p. 864, Pl. ii, fig. 1 and 2.

In the shales of Morris; Mr. S. S. Strong.

ASTEROCARPUS GRANDIS, Sp. nov.

UPPER end of a pinna, two inches long, a little more than one inch broad at the broken base, evidently part of a large frond. The lanceolate pinna is simply divided into alternate, open, lanceolate, obtuse pinnules, one-fifth of an inch broad at their connate base, and one-half of an inch long, with a smooth surface or with merely an obscure medial nerve, without other traces of nervation. The fructification is marked by large starlike *sori*, placed near the borders of the pinnules, four on each side, one at the top, with six to ten sporange-cells pointed towards the center, obtuse to the outward. The form of the sporanges is the same as in *Asterocarpus Sternbergii*, Gopp., Foss. Farn., p. 188, pl. 6, fig. 1 and 2, but they are larger and more distant from each other. The form of the pinna and of its division is also totally different in our species.

Mazon creek; S. S. Strong.

A number of specimens, representing fruiting pinnæ of *Pecopteris* or *Alethopteris*, have been recently obtained from Mazon creek, but are left undescribed, the essential characters, form and position of the *sori*, nervation, etc., being too obscure for a satisfactory diagnosis.

HYMENOPHYLLITES FURCATUS, Brgt.

Veg. Foss., p. 179, Pl. 49, fig. 4 and 5.

A few small specimens of this species have been collected by Mr. S. S. Strong, from the roof shales of Morris. It is rather a sub-conglomerate species, being found most abundant at the base of the mill-stone grit, or the top of the red sandstone, in the anthracite basin of Pennsylvania.

STIGMARIOIDES? RUGOSUS, Sp. nov.

As much as can be seen from two specimens obtained in concretions at Mazon creek, by Mr. S. S. Strong, the stem is cylindrical, two to three inches in diameter, marked with circular depressions, points of insertion of branches, or rootlets diverging from it all around, enlarged at base, cylindrical, flattened by compression, tapering or diminishing in size from the base, half an inch broad to the top, one-fourth of an inch in diameter, where these rootlets are broken, two and a half inches from the points of insertion. Their surface is wrinkled and narrowly striate in their length, and marked by small round holes, which appear as the basilar points of attachment of branches of rootlets. The cross section of half a cylindrical stem is obscurely seen, and appears to be marked by broad tubercles like those of a stem of a *Calamites*, only much larger. There is nothing published as yet, which can compare with these fossil remains, but the roots of *Equisetum Mougeotii*, Schp., Pal. Veg., pl. 13, fig. 9. I consider them as representing the rhizomas of some *Equisetaceæ*.

DISTRIBUTION OF THE FOSSIL FLORA OF THE ILLINOIS COAL FIELDS.

The following table enumerates all the species of fossil plants known to this time, (March, 1870,) from the Coal Measures of Illinois, and indicates the location where the specimens representing them have been found. This synopsis of the fossil flora of the Illinois coal fields may serve to elucidate the remarks which have been suggested by the study of this flora. The figures marked on the table show approximately the proportion of specimens which represent each species: 1, for example, for a species represented by less than five specimens; 12 for a species represented by one hundred or more.

List of Fossil Plants.	Duquoin.	Murphysborough.	Colchester.	Morris.	Mazon creek.	Other localities.
1. Chondrites Colletti, Lesqx..........	....	....	....	....	....	Lodi, Indiana.
2. Neuropteris hirsuta, Lesqx..........	2	12	4	4	12	
3. " angustifolia, Brgt.......	....	....	....	....	1	
4. " fasciculata, Lesqx.......	....	....	....	....	1	Neeleyville.
5. " Collinsii, Lesqx.........	....	....	...	1	1	
6. " flexuosa, Brgt....... ..	....	6	....	1	...	Alton.
7. " fimbriata, Lesqx...	....	1	....	....	1	
8. " rotundifolia, Sternb.....	...	....	....	....	....	Alton and Grayville.
9. " capitata, Lesqx..........	....	1	....	....	1	
10. " plicata, Sternb.........	....	....	....	....	1	
11. " Loschii, Brgt...........	....	2	....	....	2	Abounds at Grayville.
12. " microphylla, Brgt.......	....	....	....	....	1	
13. " tenuifolia, Brgt.........	....	2	2	2	2	Grayville.
14. " vermicularis, Lesqx.....	....	2	....	....	2	
15. " rarinervis, Bunb.......	1	4	4	6	6	
16. " Villiersii, Brgt...	....	1	....	....	....	
17. " Clarksoni, Lesqx........	....	....	...	....	2	
18. " inflata, Lesqx..........	....	....	....	....	2	
19. " coriacea, Lesqx........	....	....	....	....	1	
20. " heterophylla, Brgt......	....	...	....	....	....	Rock Island.
21. " Desorii, ? Lesqx........	....	....	....	....	1	Still doubtful.
22. " Evenii, Lesqx....... ..	....	....	....	..	1	
23. " verbenæfolia, Lesqx.....	....	....	....	....	2	
24. " crenulata, ? Brgt........	..	....	....	....	1	
25. " pachyderma, Lesqx......	....	....	....	....	1	
26. Dictyopteris rubella, Lesq..........	....	6	....	....	....	

LIST OF FOSSIL PLANTS.	Duquoin.	Murphysborough.	Colchester.	Morris.	Mazon Creek.	Other localities.
27. Odontopteris Worthenii, Lesqx					2	
28. " heterophylla, Lesqx		3			1	
29. " subcuneata, Bunb					1	
30. " Bradleyi, Lesqx					1	
31. " Schlotheimii, Brgt				4	1	
32. " æqualis, Lesqx					1	
33. Alethopteris serlii, Brgt		6		8	6	
34. " aquilina, Brgt	3		2	2		
35. " Pennsylvanica, Lesqx				1		
36 " Massillonis, Lesqx					1	
37. " Mazoniana, Lesqx					3	
38. " Owenii, Lesqx					1?	
39. " crenulata, Brgt					4	
40 " hymenophylloides, Lesqx					1	
41. " Hallii, Lesqx					1	
42. " inflata, Lesqx					1	
43. " erosa, Gutb				8		
44. " cristata, Gutb				1		
45. " muricata, Brgt					1	
46. " nervosa, Brgt		1		1	1	
47. " Plukneti, Brgt				1		
48. " callosa, Lesqx		2		1		
49. " spinulosa, Lesqx	1					
50. " falcata, Lesqx					1	
51. " lanceolata, Lesqx					1	
52. " emarginata, Gopp					2	
53. " longifolia, Brgt					1	
54. " solida, Lesqx					1	
55. " stellata, Lesqx					1	
56. Callipteris Sullivanti, Lesqx			6	8	4	
57. Pecopteris Strongii, Lesqx				3	2	
58. " Sillimani, Brgt					1	
59. " squamosa, Lesqx			2	2	2	
60. " arguta, Brgt				3	1	
61. " Candolliana, Brgt					1	
62. " cyathea & arborescens? Bgt					1	
63. " aspidioides, Brgt					1	
64. " lepidorrhachis, Brgt					2	
65. " hemiteloides, Brgt					1	
66. " villosa, Brgt	1	2	4	6	12	
67. " velutina, Lesqx						?
68. " oreopteridius, Brgt		1		3	2	
69. " Bucklandi, Brgt						Little Vermilion riv.
70. " pteroides, Brgt					1	
71. " Cistii, Brgt					1	
72. " polymorpha, Brgt						Abounds at Grayville
73. " abbreviata, Brgt					5	
74. " unita, Brgt	3		8		12	
75. " elegans? Germ					3	
76. " dentata, Brgt				2	2	
77. " plumosa, Brgt	3		8	6	1	
78. " flavicans? Presl					2	
79. " Murrayana, Brgt					1	
80. " chærophylloides, Brgt			2	2		
81. " Newberri, Lesqx					1	
82. Asterocarpus grandis, Lesqx					1	
83. Staphylopteris Wortheni, Lesqx					1	
84. " asteroides, Lesqx				1		
85. " sagittatus, Lesqx					1	

List of Fossil Plants.	Duquoin.	Murphysborough.	Colchester.	Morris.	Mazon creek.	Other localities.
86. Sphenopteris scaberrima, Lesqx	....	....	....	1	....	
87. " gracilis, Brgt	....	....	....	3	....	
88. " mixta, Schp	....	...	....	4	....	
89. " paupercula, Lesqx	1	....	....	....	....	
90. " irregularis, Sternb	...	....	2	....	....	
91. " obtusiloba, Brgt	....	1	....	....	....	
92. " latifolia, Brgt	...	....	....	....	1	
93. " trifoliata, Brgt	....	....	2	...	....	
94. " abbreviata, Lesqx	....	....	....	....	1	
95. " elegans, Brgt	....	....	....	....	1	
96. Hymenophyllites alatus, Brgt	....	...	1	1	2	
97. " spinosus, Gopp	....	....	2	....	....	
98. " pinnatifidus, Lesqx	3	....	....	....	....	
99. " tridactylites, Brgt	....	....	....	1	2	
100. " trichomanoides, Bgt	....	....	....	1	....	
101. " myriophyllum, Brgt	....	....	....	1	....	
102. " Schlotheimii, Brgt	..	1	....	1	....	
103. " delicatulus, Brgt	....	....	....	1	....	
104. " tenuifolius, Brgt	....	....	....	1	....	
105. " splendens, Lesqx	....	....	6	6	...	
106. " furcatus, Brgt	....	....	....	1	....	
107. " hirsutus, Lesqx	..	....	....	1	....	
108. " inflatus, Lesqx	2	....	....	....	....	
109. " adnascens, Ll. & Ht.	....	...	....	2	....	
110. " lactuca, Gutb	....	....	....	....	2	
111. " arborescens, Lesqx	....	....	....	1	...	
112. " Clarki, Lesqx	....	...	....	....	8	
113. " Gutbierianus, Presl	....	....	1	....	....	
114. " thallyformis, Lesqx	....	....	1	1	....	
115 " Strongii, Lesqx	..	....	....	....	1	
116. " mollis, Lesqx	...	....	....	....	2	
117. Pachypteris gracillima, Lesqx	....	....	....	2	...	
118. Cordaites borassifolia, Ung	2	4	2	2	2	
119. " angustifolia, Lesqx	6	....	2	1	1	
120. Sphenophyllum Schlotheimii, Brgt	2	2	4	6	2	
121. " emarginatum, Brgt	2	....	2	2	2	
122. " filiculme, Lesqx	...	....	....	....	1	
123. " cornutum, Lesqx	....	....	2	1	....	
124. Annularia longifolia, ? Brgt	....	....	...	....	2	
125. " longifolia, Brgt	1	1	2	2	6	
126. " inflata, Lesqx	...	...	....	....	4	
127. " sphenophylloides, Brgt	....	2	2	3	3	
128. Asterophyllites rigidus, Brgt	....	....	....	2	2	
129. " longifolius, Gopp	....	....	....	1	...	
130. " grandis, Ll. and Hutt	.	....	....	3	....	
131. " equisetiformis, Brgt	1	....	1	2	1	
132. " sublævis, Lesqx	...	....	....	....	1	
133. " lauceolatus Lesqx	....	....	....	...	1	
134. " ovalis, Lesqx	....	....	....	2	....	
135. " foliosus, Ll. and Hutt.	....	....	....	....	4	
136. " tuberculatus, Brgt	....	....	....	2	....	
137. Equisetites occidentalis, Lesqx	....	....	....	....	1	
138. Calamites Suckowii, Brgt	....	....	....	....	2	and Carmi, abundant.
139. " ramosus, Brgt	1	2	2	2	1	
140. " cruciatus, Brgt	1	....	....	2	...	
141. " nodosus, Brgt	....	.. .	....	2	1	
142. " Cistii, Brgt	....	....	....	....	1	and Grayville.
143. " pachyderma, Brgt	....	...	....	....	....	?
144. " bistriatus, Lesqx	....	....	....	....	....	?

	List of Fossil Plants.	Duquoin....	Murphysborough.	Colchester...	Morris	Mazon creek.	Other localities.
145.	Calamites approximatus, Brgt.......	1	....	1	2	1	and Carmi,
146.	" undulatus, Brgt..........	....	....	1	....	....	
147.	Artisia transversa, Sternb..........	....	....		....	1	Grayville.
148.	Selaginites uncinnatus, Lesqx.......	....	....	2	....	....	
149.	" carifolius, Lesqx........	....	...	1	....	....	
150.	" crassus, Lesqx.........	....	..	....	....	2	
151.	Lycopodites annulariæfolius, Lesqx...	....	....	....	....	1	
152.	" Meekii, Lesqx...	....	....	....	1	....	
153.	" asterophyllitæfolius, Lesq.	....	....	..	....	1	
154.	Schutzia bracteata, Lesqx....	....	....	....	....	1	
155.	Lepidodendron rigens, Lesqx.........	....	....	....	....	1	
156.	" Morrisianum, Lesqx..		....	....	1	....	
157.	" forulatum, Lesqx. ...	1	....	....	....	....	
158.	" Tijoui, Lesqx........	2	....	....	....	....	
159.	" diplotegioides, Lesqx..	....	....	1	...	....	
160.	" Worthenii, Lesqx....	....	2	....	....	....	
161.	" turbinatum, Lesqx....	....	....	....	....	....	Carol's place, Chester group.
162.	" costatum, Lesqx.....	....	....	....	....	....	
163.	" obscurum, Lesqx.....	....	....	....	....	....	
164.	" radicans, Lesqx	1	....	....	....	....	
165.	" simplex, Lesqx.......	....	...	2	....	....	
166.	" modulatum, Lesqx....	....	....	....	1	1	
167.	" clypeatum, Lesqx.....	....	....	....	....	....	Rock Island.
168.	" rugosum, Brgt	....	....	...	...	....	Little Vermilion.
169.	" obovatum, Sternb ...	....	....	3	3	1	and Rock Island.
170.	" gracile & elegans, Brgt.	....	....	3	4	1	
171.	" Veltheimianum, Stern.	...		....	....	....	Chester group.
172.	" dichotomum, Sternb..	....	....	....	2	....	
173.	" mammillatum, Lesqx.	....	....	....	2	....	
174.	" cruciatum, Lesqx.....	....	....	....	1	....	
175.	" Greenii, Lesqx.	..	....	....	...	..	Mercer county.
176.	Ulodendron majus, Ll. and Hutt	....	....	1	4	....	
177.	" ellipticum, Ll and Hutt..	....	....	3	4	....	
178.	" elongatum, Lesqx.......	....	....	....	2	....	
179.	" punctatum, Sternb......	....	....	....	....	....	Vermilion co., Ind.
180.	Lepidophloios? auriculatum, Lesqx..	2	....	. .	....	....	
181	" laricinum, Sternb....	....	....	....	3	....	
182.	" protuberans, Lesqx...	....	....	...	2	....	
183.	" obcordatum, Lesqx...	1	...	1	....	....	
184.	Lepidostrobus species....	....	....	....	....	1	
185.	" princeps, Lesqx.......	4	....	1	1	....	
186.	" ovatifolius, Lesqx......	....	....	....	....	2	
187.	" oblongifolius, Lesqx...	....	....	....	....	2	
188.	" hastæfolius, Lesqx.....	....	...	....	....	1	
189.	" lancifolius, Lesqx	....	...	....	....	1	
190.	" truncatus, Lesqx......	....	....	....	....	1	
191.	" connivens, Lesqx......	....	....	...	....	1	
192.	" ornatus, Brgt.........	....	....	....	...	1	
193.	Lepidophyllum lanceolatum, Brgt....	....	....	...	2	1	
194.	" majus, Brgt........	....	....	....	2	....	
195.	" auriculatum, Lesqx..	2	....	1	....	....	and Neelyville.
196.	" rostellatum, Lesqx...	..	....	....	....	1	
197.	" striatum, Lesqx.....	...	....	....	....	1	
198.	" foliaceum, Lesqx....	...	1	....	1	....	
199.	Knorria imbricata, Sternb and Gopp..	....	....	....	...	....	Chester group.
200.	" Selloni, Sternb............	....	....	....	2	....	
201.	Sigillaria monostigma, Lesqx.......	...	....	3	1	...	
202.	" sculpta, Lesqx...	1	....	....	...	....	

List of Fossil Plants.	Duquoin. .	Murphysborough. . .	Colchester. .	Morris.	Mazon creek.	Other localities.
203. Sigillaria Brardei, Brgt.	1	...	...	....	....	
204. “ tessellata, Brgt.	....	1	....	....	....	Carmi.
205. “ intermedia, Brgt.	....	....	....	....	....	“
206. “ spinulosa, Germ.?	....	....	....	....	....	Marseilles, Ill.
207. “ corrugata, Lesqx.	....	....	....	....	....	Big Vermilion.
208. “ Massiliensis, Lesqx.	....	....	....	....	....	?
209. “ Yardleyi, Lesqx.	....	....	....	....	....	
210. “ reniformis, Brgt.	....	...	....	....	....	
211. “ alternans, Ll. and Hutt.	....	....	....	1	....	
212. “ Cistii, Brgt.	....	..	....	1	....	
213. Syringodendron pachyderma, Brgt.	....	...	....	....	....	?
214 “ Porteri, Lesqx.	....	....	....	....	...	Gallatin county.
215. “ pes-capreoli, Brgt.	....	....	....	....	....	Grayville.
216. “ cyclostigma, Brgt.	....	....	...	....	....	Alton.
217. Sigillarioides radicans, Lesqx.	....	....	....	....	1	
218. “ stellaris.	....	....	....	1	...	
219 Halonia tuberculata, Brgt.	....	....	...	....	....	Chester group.
220. Stigmaria ficoides, Brgt.	2	2	6	6	2	
221. “ elliptica, Lesqx.	1	....	....	2	....	
222. “ umbonata, Lesqx.	....	....	8	....	....	
223. Stigmarioides Evenii, Lesqx.	...	....	....	...	2	
224. “ truncatus, Lesqx.	....	....	....	....	1	
225. “ tuberosus, Lesqx.	....	....	....	....	1	
226. “ villosus, Lesqx.	....	....	....	....	2	
227. “ linearis, Lesqx.	....	....	....	....	1	
228. “ affinis, Lesqx.	....	....	....	....	1	
229. “ selago, Lesqx	....	...	....	....	1	
230. “ rugosus, Lesqx.	....	....	....	....	1	
231. Pinnularia capillacea, Ll. and Hutt.	2	2	4	4	....	
232. Megaphytum protuberans, Lesqx.	....	....	....	....	....	Chester group.
233. “ McLayi, Lesqx.	2	....	....	....	1	
234. Caulopteris insignis, Lesqx.	1	....	....	....	....	
235. “ Worthenii, Lesqx.	....	....	...	....	....	Carmi, White co.
236. “ obtecta, Lesqx.	....	....	6	4	....	
237. “ intermedia, Lesqx.	...	....	...	....	....	Fulton county.
238. “ acantophora, Lesqx.	....	....	8	2	....	
239. Trigonocarpum Nœggerathii, Ll. & Ht.	....	...	....	....	1	[co., Ind.
240. “ olivæformis, Ll. & Ht.	....	....	....	....	....	Eugene, Vermilion
241. “ juglans, Lesqx.	....	1	....	....	....	
242. “ rostellatum, Lesqx.	....	....	...	....	....	Grayville.
243. Rhabdocarpus clavatus, Sternb.	....	....	....	....	1	
244. “ mammillatus, Lesqx.	....	....	....	....	1	
245. Carpolithes multi-striatus, Sternb	....	....	8	8	1	
246. “ Jacksonensis, Lesqx.	...	2	....	....	1	
247. “ cistula, Lesqx.	....	1	...	....	....	
248. “ fasciculatus, Lesqx.	....	....	....	....	....	Grayville.
249. “ corticosus, Lesqx.	....	....	....	....	1	
250. “ persicaria, Lesqx	....	1	....	....	....	
251. “ vesicularis, Lesqx	....	1	....	2	...	
252. “ bullatus, Lesqx.	....	....	....	..	1	
253. Sigillaria semina?	....	....	....	1	1	
254. Palæoxyris Prendeli, Lesqx.	....	....	....	....	2	
245. “ appendiculata, Lesqx.	....	....	....	..	1	
256. “ corrugata, Lesqx.	....	....	....	...	1	

This table enumerates 256 species of fossil plants, or more than double the number of those which were known from Illinois at the time when the second volume of the State Geological Report was published. The catalogue of the American fossil plants which served as a point of comparison for the table prepared for that volume, p. 464, enumerates 280 species, (120 from Illinois) even comprising some pertaining to the Devonian strata. It is, therefore, evident that the assertion, concerning the insufficiency of our knowledge of the flora of the Coal Measures of Illinois and of the future discoveries promised to continued researches, is fully corroborated by facts. Of the recently discovered species, seventy-nine are considered as new, and forty, though known already from Europe, had not been recognized before in our American Coal Measures.

The species marked in the table as from Morris and from Mazon creek, are from the same geological horizon. The bed of shale overlaying the coal at Morris covers, apparently, the whole extent of the Coal Measures of Grundy county. At Morris, this shale contains but few nodules or concretions, while at Mazon creek these nodules are found quite abundant, having been washed from the shales into the bed of the creek. The two localities are separated in the table merely to indicate the proportion of species preserved in shale or in concretions, and to show the difference in the nature of the fossil remains. About 180 of the species enumerated in the table have been found at Morris and Mazon creek. This remarkable predominance is due to peculiar circumstances:

1st. It is at and around Morris that an uninterrupted series of researches has been pursued by the two ardent and clever investigators, Messrs. Jos. Even and S. S. Strong, so often named in this Report. Researches of this kind, in which the miners often become interested and afford valuable assistance, offer the best chances to make new discoveries. They also enable the observer to obtain, when still in place and before the fragments are scattered, specimens of the different parts of a plant; to compare the different organs, or the same organs in different positions, and thus to become better acquainted with the true nature, and with the variations of forms of the same vegetable.

2d. In the shale of Morris, there is not only a great abundance of remains of plants, but the coal which it covers is opened either by shafts, or by drifting at numerous and distant places, and therefore the flora is exposed in its local varieties. The distribution of plants in the coal epoch was evidently governed by the same laws as is now the vegetation of our swamps. There was a general uniformity of species, with a constant diversity of groups on small areas· As we see now in the peat bogs, here the ferns, there the grasses, or the rushes or the mosses, according to the degree of humidity of the surface, which varies at every step, we find, in examining the fossil plants of a given area, a constant recurrence of the same species at the same place, and a diversity only at a distance in various directions.

At Mazon creek, the meanders of the stream have dug a broad bed through the same bank of shale, and the water, washing for centuries, has uncovered great numbers of concretions and scattered them for miles from their point of origin. As a whole, therefore, the concretions represent the characters of the flora of a large area. No other place in the Illinois coal field has afforded the same advantages for research.

The shales at Colchester, Murphysborough and St. Johns, are rich in vegetable remains; but little has been done there in the way of collecting specimens of fossil plants, except by the assistants in the Survey. And from the above remarks it is easy to understand that researches made in passing, or remaining at a place only for a short time, are far from affording the chances of valuable discoveries. It is, therefore, very probable, that these last named localities have still in reservation a good many species of coal plants which are now unknown to us, and that the fossil flora of Illinois is far from being fully known at the present time.

The Report on the Flora of the Coal Measures of Illinois should have been closed here, but for the recent publication of a remarkable work on vegetable palæontology. (1) Among other matters of general interest, this work is prefaced by some discussions on the cause and nature of phenomena attending the preservation or fossilization of vegetable remains. It also describes and critically reviews most of our new species published in the 2d vol. of the Ills. Geol. Report. This, of course, is a reason for considering, from American observations, some well established facts which corroborate or invalidate the conclusions of the celebrated author. It also provokes a discussion on the value of some of our species, and on their affinity with the flora of the Carboniferous Measures of Europe. And further, it now becomes of importance to review the conclusions which have already, or should be hereafter drawn, on the geographical and stratigraphical distribution of our species of fossil plants in relation to geology, and to fix some reliable points of reference for future researches on the subject.

---

(1) Traite de Paleontologie vegetale par W. Ph. Schimper. Paris, Bailliere & fils, 1869.

MODE OF PRESERVATION OF VEGETABLE REMAINS IN OUR AMERICAN COAL MEASURES.

§ 1st. REMAINS OF PLANTS IN COAL.

It has been erroneously asserted that the coal itself does not contain any recognizable vegetable remains, it being merely a mass of bitumen, independent of any of the plants which are found in the shales overlaying or underlaying it. Our bituminous coal is generally a compound of supposed layers of crystalline matter, about one-eighth of an inch in thickness, separated by a thin coat of pulverulent coal, or mineral charcoal, which is a mere compound of cellular tissue and of vessels of plants. (2)

Generally, this agglomeration of broken tissue preserves some outline by which the genera, even the species to which the remains belong, can be recognized at first sight: leaflets of ferns, stems of *Calamites*, bark of *Stigmaria*, *Lepidodendron*, etc. But besides this, the coal itself, though more rarely, is marked with distinct prints of the plants of which it is a compound. This case is especially observable in a kind of hard, laminated, flint coal, obtained in Mercer county by Mr. H. A. Green, which bears on the horizontal surface of its crystalline lamellæ, however thin they may be cut, the outline and nervation of leaves and branches of ferns, and other vegetables of the coal; and these are so distinctly marked, that the most delicate parts are as easily identified as those of plants preserved in shales.

The great abundance of these remains show that the whole mass of this coal, which is true coal and burns freely, is a compound of them. In the cannel coal which has been formed under water from more decomposed vegetables, the forms are more rarely recognizable. Yet the cannel coal of Breckenridge, Ky., is marked through its whole mass by stems and leaves of *Stigmaria* and *Lepidodendron*, rendered distinct by infiltration of sulphuret of iron. Even in the anthracite coal of Penna., whose matter has been subjected to heat and fused to cohesion after the transformation of vegetable matter into coal, one can easily discover an abundance of remains of plants whose genera and even species are sometimes recognizable. These facts, which cannot be overlooked, may be taken into account in examining new theories in relation to the formation of coal.

---

(2) This fact is easily ascertained by microscopical examination. Prof. J. W. Dawson, of Montreal, has closely examined this charcoal, and published, as results of his interesting researches, numerous forms of vessels of plants. The same kind of researches had been already pursued by Prof. Goppert, who had recognized, in this pulverulent coal, remains of plants of every family hitherto known to occur fossil in the coal. (Quat. Geol. Jour., vol. 5, mem., p. 17.)

§ 2. VEGETABLE REMAINS PRESERVED IN SHALE.

It is in the clay or silicious shale that the fragments of plants of the coal epoch have been more generally preserved. When a bed of vegetable matter heaped for the formation of a coal has begun to cease its growth, its top indicates a greater scarcity of vegetable remains, mixed with a larger proportion of earthy or clayey matter. The coal then becomes a less homogeneous mass, easily separating in layers of heaped fragments of vegetable and foreign matter. By and by, the vegetation becoming scarcer by superabundance of water upon the surface of the bogs, the clay is more thickly deposited, and the vegetable remains, more rare and scattered, are more distinct and more easily recognizable. When preserved in that way, the plants or their fragments have been first slowly decomposed and softened by humidity, and then more or less flattened by compression. All the naturalists who have examined the coal formations are well acquainted with the appearance of the remains found in shale, and sometimes admirably preserved. Generally, the woody tissue of the plant has been destroyed, and the surface of the stems and branches only are preserved in a thin coat of coaly matter, bearing impressions of scars of the bark, etc. For the leaves, the coaly matter represents the whole substance, and for the ferns, especially, it preserves the exact form of the vegetable and is marked by the impression of veins and veinlets, mostly distinct to their last divisions. Some leaves of a coriaceous texture have their epidermis hardened by mineralization, and separable from the shale like a transparent pellicle. It can then be easily examined under the microscope, and all the details of structure recognized. It is especially the case with our *Dictyopteris rubella* of Murphysborough, as also with the leaves of *Whittleseya elegans*, Newb., of Ohio. Sometimes the leaves of *Neuropteris hirsuta* have been heaped and compressed together in such quantity, that the pinnules are separable from each other as a carbonaceous cuticle, preserving traces of the primitive organism.

The shales, according to the amount of vegetable matter mixed in them, and the depth at which they have been formed under water, are of a more or less dark color; whitish or yellowish when of fresh water origin, and with few remains of plants; black and generally more homogeneous when formed in deep water, and having for a larger proportion of their compound, broken remains of organized beings. In this case the remains are either animal or vegetable mixed together, both fragments of moluscs and fishes with fragments of plants recognizable on the same piece of shale, or mere remains of animals or only plants. These various appearances are easily explained in considering the phenomena accompanying the formation of tha coal strata, from deposits analogous to those of our existing peat bogs. For the surface of these bogs, even in our time, shows the same differences in the superposed deposits, according to the depth and chemical compounds of the water by which they become covered, either by casual inundation in the interior of the land, or by slow immersion near the borders of lakes or sea shores. Even where the coal and shales, from the amount of remains of fishes which they contain, appear to have been formed in water of a certain depth, the matter always bears evident traces of its origin from land vegetation, and never from marine plants. The lower part of a bed of coal, worked near the mouth of Yellow creek, Ohio, is a kind of cannel coal, or very bituminous compact shale, full of the remains of fishes, whose entire skeletons vary in length from one inch to one foot. Yet this shale has an abundance of the remains of land plants mixed in its compound. The same case is observable in Kentucky—for example, at Airdrie, on Green river, where the upper coal (No. 11 of the Kentucky section,) is overlaid by a bituminous laminated shale, containing teeth of large fishes with trunks of *Sigillaria*, *Lepidodendron*, etc., and branches and leaves of ferns. Those who have examined our immersed peat bogs along the shores of New Jersey, have seen in activity a formation of the same kind, where logs of large trees are fished from a depth of ten or fifteen feet, out of beds of peat submerged in water deep enough to feed a variety of fishes; while here and there, small islands, half floating fragments of wood or heaps of mud, are covered with a luxuriant growth of ferns, reeds or bushes, which throw their debris to the surface, to be conveyed to the bottom and there mixed in the bed of mud, an incipient shale, with animal remains.

Among the various metamorphoses to which remains of plants have been subjected in the shale by compression, decomposition and other chemical and mechanical agencies, one peculiar phenomenon is worth noticing here. In the shale covering the bed of anthracite of Rhode Island, the whole carbonaceous matter of the plants has been destroyed by heat, and the mere skeleton of the leaves and other remains is marked upon the shale as a more or less distinct mould, often covered by a whitish incrustation of selenite. In this process of fusion, the vegetable fragments have been distorted in such a way that they often present an appearance far different from that of the species to which they belong. For example, in some branches of ferns, the leaflets have been, on one side of the pinnæ, extended to double their original length, and narrowed in proportion, while on the other side they have been relatively contracted and widened. Without an examination of the shale at Newport, it would be difficult to account for such a metamorphosis. At this locality, the shales present along the shore a series of low undulations, resembling slightly elevated waves; and there one can see that, in the state of fusion of the whole mass, the remains of plants, following the force of upheaval, have been, at peculiar places, drawn upwards and therefore elongated on one side, and of course drawn on the other towards the rachis. It is peculiar that the rachis and stems do not show any appearance of flexure and of deformation, and it is remarkable also that the same phenomenon of dimorphism is not observable on the plants found in the shale of the anthracite basin of Pennsylvania, where the flexures of the veins of coal are often abrupt, and where traces of tortion are frequently seen upon fragments of the combustible mineral. This deformation of vegetable remains may give an idea of the difficulties encountered by the palæontologist in studying, as he has to do, mere fragments of plants in their fossil state. Not only do these remains generally insufficiently represent the whole vegetable, but often they are deformed by various forces and influences, to which they are subjected in the process of mineralization.

§ 3. VEGETABLE REMAINS PRESERVED IN FERRUGINOUS CONCRETIONS.

As far as we know, from the specimens abundantly found in Illinois, the mode of preservation of fossil plants in concretions is somewhat different from what it is in argillaceous shale. These concretions are found, especially in the shale of Grundy county, irregularly scattered from top to bottom of the strata, in the form of oval, more or less elongated, generally slightly flattened concretions. They appear to have been formed by superposition of concentric layers of slowly deposited carbonate of iron or ferruginous clay around central nuclei, which are most commonly parts of plants, bones of fishes or the remains of insects and crustacea. Their size and form vary according to that of the body around which the deposit has been made. Some small leaflets of ferns are found in nodules which are not larger than a walnut; pieces of calamites are inclosed in cylindrical concretions varying in length from two inches to one foot or more; pinnæ of ferns or of *Asterophyllites* have been discovered in flattened concretions measuring about one square foot and only two inches thick, their form agreeing more or less with that of the body around which they have originated, though always showing an oval or round outline, by superposition of concentric layers. It is not yet clear whether the flattening of some of the specimens is the result of compression. Generally, the nodules which have cylindrical pieces of stems, or nutlets for nuclei, are round or exactly oval, while they are flattened for pieces of ferns, in proportion to the breadth of the fragments which they have entombed.

The origin of these concretions has been explained in admitting a general tendency of some mineral bodies to *concentrate around centers, whether solidifying from fusion, solution or vapors.* (1) This explanation may be satisfactory in regard to other kinds of concretions, but from their peculiar position, their form and size, varying according to the nature and outline of the bodies which they contain, the nodules of Mazon creek rather seem to be the work of infusoria or *Bacillaria* concentrating molecules of iron around some centers, as it now happens in the formation of the bog iron ore, or in other deposits, in springs or pools, whose waters contain a solution of iron. This supposition appears confirmed by the manner in which the bodies in concretions have been preserved and selected for preservation. Though generally mere fragments, their integrity is complete, and yet some of them are of very soft texture. The pinnæ or leaflets of ferns are always found in them in a flattened position, their axis or rachis extending through the center of the elongated nodule, with the divisions on both sides; the surface of the pinnules, slightly swollen, as when in their living state, is marked by recognizable hairs or fruit dots, with distinct veins and veinlets, and their appendages, like the scales, are seen in the various modifications which they present in living specimens; for example, long, straight, flat, diverging, on primary rachis, and becoming shorter, ruffled and curled on their upper divisions. The small organs of plants appear, therefore, in a better state of preservation than in the shales. With small animals like crustaceans, scorpions, insects of a fleshy and very delicate texture, the preservation of form is still more remarkable. They are found entombed in the middle of the nodules just as if they were in life, or as if they had been transformed into stone while still living. The fruits or nutlets are not flattened. By the section of the nodules, which generally break into two equal halves by hard strokes on their edges, the middle and internal part of the fruit is exposed to view, while the outside surface is immersed in the stone. The numerous cones also of *Lepidodendron* found in these concretions are equally well preserved, either whole or in part, by horizontal cross sections. Some specimens not only show distinctly the pedicels of the sporanges and the blades in their natural position, but even sporanges with their seeds have been found in them, without perceptible alteration. In the cross section of these *Lepidostrobi* the sporange cells form a central row, which is surrounded by the blades in the form of a star.

Peculiar species of plants and animals, or their fragments, seem to have been selected as the nuclei of these nodules. They contain, for example, an abundance of leaflets of various species of *Neuropteris*, especially *N. hirsuta*, of *Alethopteris Serlii*, of *Pecopteris villosa*, *P. abbreviata*, *Hymenophyllites Clarkii*, *Annularia longifolia*, *Stigmarioides*, etc., which are either rare or have not yet been found in the shale at Morris, while these shales are rich in the remains of *Odontopteris Schlotheimii*, *Alethopteris erosa*, *Ulodendron*, *Carpolithes multistriatus*, scarcely or not at all preserved in concretions. As the bank of shale bordering the bed of Mazon creek has not yet been opened, these differences may result from geographical distribution. Yet, as the animals and plants of soft exture, like the species of the genus *Sigillarioides*, have not yet been found in the shale of our American Coal Measures, it is evident that these remains have been generally destroyed by maceration, and only escaped total destruction by their entombment in these nodules. The same can be remarked on the remains of small animals. The remains of fishes found in these concretions are merely bones, scales and coprolites, while of molluscs, they have afforded only some agglomerations or very small shells.

---

(1) Dana's Manual of Geology, p. 626.

§ 4. VEGETABLE REMAINS PRESERVED BY MINERALIZATION OR TRUE PETRIFICATION.

This kind of fossilization is performed by slow infiltration of mineral matter into the substance of the vegetable, when in a soft state of decomposition. The phenomenon is produced either by a total destruction of the vegetable substance, for which sand, clay or oxyd of iron is substituted by infiltration, or by a slow, still unexplained mineralization of the vegetable substance, by silex or lime. By the first process, the whole texture of the vegetable is destroyed, except the surface, preserved as in a mould, which shows the original outline of the vegetable, and bears the cicatrices of the bark and other external characters, which often render it recognizable. These moulds, generally covered by a coat of coaly matter, are rarely flattened by compression, and mostly represent trunks or branches of large size, sometimes fruits of a hard consistence, rarely branches and leaves of ferns. They abound in the sandstone beds of our Coal Measures, and some of our new species of *Lepidodendron* and of *Sigillaria* have been described from specimens of this kind. In the second case of petrification, on the contrary, the surface or outside of the vegetables is generally obliterated, as if it had been more or less decayed while subjected to mineralization, while the internal structure is preserved in its minutest details, and so distinctly, that it can be studied under the microscope when lamellæ of the fossils are detached, and polished thin enough to become transparent. Specimens of wood fossilized in this way, though often remarked in the Carboniferous formations of Europe, and very common in the more recent formations of this continent, have rarely been found in our Coal Measures, and none as yet have been obtained, except from Southern Ohio and Northern Kentucky. Both these processes of fossilization have acted upon vegetables already separated from their support, and more or less decayed, or upon trees still standing or still living, when they were surrounded by the mineral substances which caused their petrification. Though not quite as abundant as prostrated fossil trunks, petrified standing trees are not unfrequently obtained from the sandstone of our Coal Measures. Near New Harmony, Ind., some petrified trees, varying in size from six to twelve inches in diameter, have been obtained from a sandy shale, and transferred to his museum in their standing position, and with their roots attached to the trunks, by my lamented friend, D. D. Owen. Though entirely metamorphosed into sandstone, their mould preserves remarkably well the scars of the point of attachment of the leaves, the wrinkles of the bark, etc., and show the gradual variations which modify the form of the cicatrices in passing from the stem to the roots. True petrified forests have been observed in banks of sandstone of the Coal Measures of Pennsylvania and of Kentucky. This phenomenon should, therefore, demand but a passing notice, if it did not give rise to some discussions concerning the mode and cause of dislocation or fracture of these fossil trees, and also concerning the causes and agents of their petrification.

Fossil trees, except when observed in their standing position, still half inclosed and sustained in the matter in which they have been originally buried, are always found in pieces or broken. This is observable as well in the fossil wood of the Carboniferous measures as in that so abundantly found in more recent formations; for example, in the Cretaceous and Tertiary beds of our continent. The fracture of the pieces is of two kinds: either irregular, in various directions, like the breaking of mineral substances produced by hard strokes, or horizontal, as if by a kind of cleavage, the separate pieces forming disks or regular cylinders of various length. Generally, in both cases the fractured surface is clean, smooth, distinctly angular, and showing that in most cases, at least, the breaking of the trunks has been effected after the fossilization. Prof. Goppert, who has visited the fossilized forests of Egypt, south of Cairo, and has published the result of his researches*, has found there the trunks subjected to a kind of multiple fracture, produced at various times and in various ways; some of the trunks having their fractured surfaces obliterated as if by decay, others showing on their fragments, still closely approached to each other, evidence of recent separation. He therefore explains their fracture as due to mere atmospheric influences, especially to sudden changes of temperature, which are not rare in those regions. This explanation could be admitted for the irregular fragments of silicified wood, found in connection with our recent formations, and which, in some countries—in Arkansas and Mississippi, for example—are in some places strewn upon the ground in profusion. Agglomerations of silex are rarely homogeneous or regularly compact throughout. They are interspersed with fissures or soft veins which, when penetrated by water, expand under the influence of frost, and determine fractures in various directions. But fossil wood broken in that way is rarely found in our Carboniferous measures. Generally, the fossil trees of this formation, when separated from the mineral substances in which they were originally imbedded and petrified, show the fracture by horizontal divisions, as by cleavage, and when in a standing position, and taken out of the matter which surrounds them, they separate in disks of various lengths, and can thus be taken out in pieces, which superposed afterwards rebuild the whole trunk, without marks of any other mode of disconnection, but horizontal through fissures. In that way the different parts of the trees mentioned above, as found by Dr. D. D. Owen, have been taken out of the sandstone separately and replaced in their order of superposition, to rebuild the vegetable in its original position. At Carbondale, in Pennsylvania, a true forest of *Calamites* has been crossed in the opening of an inclined tunnel through a bank of sandstone to a bed of coal underlying it. The fragments of petrified stems taken out of this passage are in such abundance that they have been used for the construction of a kind of gangway for running the coal cars out of the mines. These fragments, nearly without exception, are mere disks, varying in length from one to four inches, without relation to the size or diameter of the stems, which measure from three to six inches; the differences in the length of the sections being as marked for the large as for the small stems. All these fragments represent only as far, at least, as I could determine from the examination of hundreds of specimens, two species of *Calamites: C. Suckowii* and *C. approximatus*, Brgt. The walls of the tunnel are adorned by a number of these trees, still in their standing position and half imbedded in the sandstone. Though these stems are continuous, they show, at various and irregular distances, horizontal fractures where they break or are dislocated at their separation from the surrounding sandstone. Some of these trunks of *Calamites*, which in their natural state were evidently hollow, have been abruptly folded or crushed, like hollow cylinders in bending under their own weight, or by some external force; but even at the point of inclination or tortion of these stems, the fracture is horizontal or perpendicular to their erect position. At Paintsville, Johnson county, Kentucky, the bottom of the river, which at some places has been cleanly washed, is marked, as in a kind of irregular mosaic work, by the broken tops of large trunks of *Sigillaria*, still in their original standing position, all horizontally fractured. One of these trunks measures twenty-two inches in diameter. The same peculiar kind of horizontal fracture is generally observable on the silicified trunks so abundantly found in some parts of Southern Ohio, especially in the bed of Shade river, near Athens. They are, most of them, pieces of stems of fern trees (*Psaronius*), varying in diameter from three to twelve inches, broken in disks from two to fourteen inches long. A few of these pieces of silicified wood are irregularly broken and disfigured on the outside by maceration; but generally they preserve their cylindrical form, and when of some length show here and there, at various distances, horizontal splits, uninterrupted all around the trunk, where a disruption is easily produced by a hard stroke. From the great bed of sandstone overlying the Pittsburg coal, near Greensburg, I have received, from Rev. W. D. Moore, large specimens of fossil wood, most of them long, irregularly broken, much decayed pieces, evidently representing sections of trunks broken lengthwise. These were found in various positions in the sandstone, and were mostly broken before they were imbedded in it. But among them there is one which bears, attached to a short stem, three diverging branches of its roots, a proof that it has been buried in its original standing position; and this one has its top horizontally broken and flat.

---

*Der Versteinerte Wald by Cairo, &c.; Acad. der Weiss: zu Wien. vol. 33, 1858.

From these data and a number of others, which it is useless to mention, being all of the same kind, and bearing the same evidence, it appears that the fracture of the fossil wood is of two kinds: irregular, for trunks fossilized after prostration or in a decaying state, as they are generally found in our Tertiary and Cretaceous strata; and horizontal, by splits perpendicular to the natural direction of the stems and the roots. If the cause of fracture in the first case is, without doubt, essentially due to atmospheric agency, that of the second, which has acted upon the vegetable while it was still subjected to the process of petrification, is certainly different, and can be explained, I think, by the difference of density of both the surrounding mineral matter and the imbedded vegetable. Evidently, all the stems in the process of fossilization have been subjected to a softening process of their whole mass. The outside pressure of the surrounding mineral matter must have been felt, and can have acted only in one way, that is, vertically, as it happens in the forcing of a body of less density out of water; and the result of that action cannot but have been a tendency to dislocation, and therefore to splitting of the trunks in a horizontal direction. It might be supposed, perhaps, that a gradual accumulation of sand or other mineral matter around standing trees, in burying them, has formed layers of different density, whose action may have produced, in the fossil vegetable, zones of petrification also varying in density, tending, therefore to cleave from each other, and horizontally separable. But the roots of fossilized trees which tend downwards in an inclined direction, or even are nearly horizontal, should be split in an inclined plane and not perpendicularly to their axis, as they are, at least, on all the roots of standing trees which I have had opportunity to examine. Moreover, the silicified stems which have been noticed above as marked by horizontal splits, are of the same compound in their whole length.

The silicified wood of the Coal Measures of Ohio, as that also of more recent formations of our continent, furnish us some valuable data for the examination of another vexed question: concerning their mode of fossilization, or rather the origin of the silica which has produced their transformation. Two opinions, above all, have been advanced on this subject. Prof. Goppert thinks that the process of petrification has been very slow, of long duration, and that to explain it, it is not necessary to suppose that the water in which the vegetable substance has been transformed, was richer in silica than it may be now in its normal state. Prof. Schimper, on the contrary, asserts that the water in which wood has been silicified should have been of a higher temperature, more abundantly saturated with silica, and therefore, he concludes that the kind of mineralization has happened in a much shorter time than is generally supposed, and by volcanic agency, as is now the case in the vicinity of the Geysers of Iceland. (1) To sustain this assertion, the celebrated professor says: that the progress of the fossilizing process should have been rapid enough to reach the whole substance of the wood before its decomposition by putrifaction. But the woody tissue, when entombed and protected against atmospheric influence, is unalterable for a considerable period of time, and slowly passes, by emerecausis, into coal. It is, therefore, conceivable that in the first stage of this slow burning, when the whole vegetable has been reduced to a soft matter, it may be penetrated by mineral fluids which, by crystallization, transform it into stone. In the valley of Locle, Switzerland, large prostrate trunks, more than fifty feet long, were discovered some years ago in a bed of sandy clay of the upper Tertiary. These trees, most of them Dicotyledonous, had their bark still in a good state of preservation, their woody tissue admirably preserved, and looked indeed as if they had been recently buried. Yet their wood was soft enough to be cut through with the knife without effort, like butter. Beds of lignites, in Germany, where the emerecausis is in a more advanced stage, contains large trunks of wood, softened in the same degree, and already blackened. In that state, the woody tissues are easily impregnated by dissolved mineral substances. But to omit theoretical discussion and merely consider facts observable around us, it is evident that our silicified wood, as well in our Coal Measures as in the more recent formations, is found in connection with strata which show no trace of volcanic agency. The silicified trunks of Southern Ohio have been washed out by the creeks from the Mahoning sandstone. The area covered by this formation, and over which the trunks are found in greater or smaller quantity, extends from Athens southward, to the Ohio river, and in Virginia, as far up the Great Kenawha river as Charleston, or about one hundred miles in a direct line. There is no trace of any volcanic agency in that country. No distubance of any kind is observable in the strata, which have their normal, slightly-marked dip to the eastward; nor does the sandstone itself indicate, in its appearance, by a variation of its compounds or of its density, any trace of metamorphism. At Gallipolis, near the mouth of the Great Kenawha, a number of fossilized trunks, still buried in the sandstone, are seen protruding from the bank, in which they have been petrified in a prostrate position. As these trees have been examined already by other geologists, and mentioned as indicating a peculiar direction of a current, by which they have been brought and deposited, a short account of them here may not be uninteresting. There are five of them, from four to fifteen inches in diameter, their length unknown, lying, two in a southeastern direction, one due east, and the two others due south. The part seen out of the sandstone is much decayed, the outer surface, where it is preserved, is covered by a coat of coal varying in thickness from one-half to one-fourth of an inch. What is most remarkable, and bears directly on the question of their petrification, is that they appear to have been transformed into stone by different substances, showing a different kind of mineralization. In one of these trees the internal texture has been destroyed, and the woody tissue is replaced by a hard calcaréous sandstone or clay, separating in layers of about one-fourth of an inch in thickness. A second is a compound of small crystals of iron flint, its interior being perforated lengthwise by a number of irregularly placed cylindrical apertures, filled with small iron crystals, forming regular stars of more than twenty rays. A third, of which I have obtained large pieces, it being of smaller size, four inches in diameter, is transformed into a compact, opaque, black silex, which does not preserve any trace of organic structure. (1) As these trees, of course, have been petrified where they are found now, it would appear as if different mineral substances, held in solution in the water, had acted upon the woody tissue in different ways, according to its nature. In any case, it is evident that the petrification has been performed in various ways, by the slow action of the liquids penetrating the sand, and not by the uniform crystallization of silica as it is now produced in the hot springs of volcanic origin. This is more evident, in considering silicified wood of our more recent formations. Neither in the plains of Kansas and Nebraska, nor in Eastern Arkansas, nor in Mississippi and Ohio, where fossilized wood is found generally associated with a ferruginous argillaceous sandstone, is there any trace of volcanic agency. There is merely an evident relation of this kind of fossilization with the deposition of iron. In Ohio and Virginia, that part of the Mahoning sandstone containing silicified trunks, borders, and perhaps overlays in part, the area where the richest and most numerous beds of iron ore have been deposited. In the recent formations, the fossilized wood is generally associated with the red or ferruginous clay. Even in the small area occupied by our Post Tertiary formation at Barlow, Ohio, disks of silicified fossil wood of dicotyledonous species are found in a bed of red ferruginous clay, associated with species of shells of the genus *Anodonta*, entirely transformed into a compact mass of oxyd of iron.

---

(1) Traite de Pal. Veget., p. 38 and 39.

---

(1) It is marked by inflated articulations, like a species of *Anarthrocanna*, Gopp., and is as yet the only specimen found in our Coal Measures which might be compared to the trunks seen by Prof. Brongniart in the coal mines of St. Etienne, France, and compared to Bamboos, from their inflated articulations. (Lyell. Manual, 4th ed., p. 319.)

§ 5. THE FLORA OF THE CARBONIFEROUS MEASURES OF ILLINOIS, CONSIDERED IN SOME OF ITS AFFINITIES.

As a whole, the coal flora of Illinois has, like that of our American Coal Measures, the general character of the Carboniferous flora of the whole world. It is well known that the representatives of this flora mostly pertain to a single class of vegetables: that of the acrogenous or vascular cryptogamous plants, containing the three families of *Equisetaceæ*, *Filices* and *Lycopodiaceæ*. The nodules of Mazon creek, where fragments of plants, even of the softest texture, have been preserved in their integrity, offered a good opportunity for examining the often proposed question: whether plants of a lower or of a higher order than those could not have entered into the compound of the coal, and, from a peculiar consistance of tissue, have been destroyed by maceration, without leaving any traces of their primitive forms. This has been affirmed, for example, of the *Algæ* or marine plants, which have left their remains in abundance in the Lower Carboniferous and Devonian strata, and also of the small cellular vegetables, *Fungi* and *Lichens*, which, at the present time, live on the bark of the trunks and branches of our trees, and are also observable, in the same circumstances, in the Tertiary and Cretaceous formations. I have already remarked, that no remains of any kind of marine plants have as yet been observed in the concretions of Mazon creek.* This is the more noticeable, as some of them have for nuclei bones of fishes of moderate size. As the so-called *Fucoides* have also never been seen in any bed of shale overlying coal strata, it is reasonable to conclude that the remains of these plants have not contributed

---

*Since this report was written, two or three nodules have been obtained from Mazon creek, inclosing marine shells, one of which is an *Aviculopecten*, and the others probably referable to the genera *Nucula* and *Polyphemopsis* or *Macrocheilus*, and indicate that these Mazon creek shales were probably an estuary deposit, in which the remains of marine animals were sparingly intermingled with the fauna and flora of the adjacent land. A. H. W.

in any way to the formation of the coal. But this is not a sufficient reason for asserting their non-existence at the Carboniferous epoch. *Chondrites Colletti*, Lesqx., collected from Lodi, Ind., and found in connection with a bed of limestone overlying a thin coal at the base of the true Coal Measures, or just above the mill-stone grit, like *Caulerpites marginatus*, Lesqx., from an analogous station in Pennsylvania, are sufficient proof of the existence there of marine vegetables already of a high order. But marine *Algæ* could not live in the low swamps where the coal was in process of formation, no more than they could live now on the surface of the peat bogs, even of those which extend along the sea shores. These plants had then, as they have now, a domain of their own; they have casually been brought to live upon a limestone formed under deep water, as the roof of a coal bed, but no remains of them could enter into its compound.

Of *Epiphyllæ*, small *Fungi* or *Lichens*, as parasites of stems and leaves, the concretions of Mazon creek have also no trace. They have, however, in great quantity that peculiar small organized body, *Gyromices Ammonis*, Gopp., which some European naturalists still persist in considering as a *Fungus**. In the nodules the white, shining, bony substance of this small *Serpulidæ* is better preserved still than in the shale, and the tissue of fragments of thick leaves, wherein it burrowed, is often perforated like a sieve, by the removal of this shell after the destruction of the epidermis.

The reason generally given for the non-appearance of remains of small, cellular, vegetables, like *Fungi* or *Lichens*, upon the bark of branches and trunks of the Coal Measures, is, that the maceration of the woody tissue and its softening has necessarily detached these small bodies from their place of origin. But if this was the real cause of their disappearance, small vegetables of this kind should have been preserved in the nodules of Mazon creek, as well as the small vegetable organs, scales, hairs, fruit dots, and even seeds of *Lycopodiaceæ*, which are as much exposed to separation and destruction by the process of maceration. We find, moreover, a large number of these small plants in the fossil remains of the Cretaceous and Tertiary formations, upon fragments of wood, which have been exposed, before their petrification, to maceration, just as much as the plants of the Carboniferous period. As these parasitic *Fungi* and *Lichens* are at our time of rare occurrence on ferns, as also on *Lycopodiaceæ* and *Equisetaceæ*, I would rather admit that their appearance is cotemporaneous with that of the exogenous plants, on which they especially thrive, and that species of this class, and also of mosses and *Hepaticæ* had scarcely any representatives in the vegetable world before the end of the palæozoic period.

---

*Prof. W. P. Schimper places it in species of doubtful affinity in his Pal. Veg., p. 144 In his Permain Flora, Goppert has it still as a Fungus.

The shale of the coal at Morris and the concretions of Mazon creek have furnished also a number of specimens of three species, or rather forms, of *Palæoxyris*, a kind of organism which is considered by Brongniart, Schimper, and other naturalists, as a plant belonging to a higher class of the vegetable kingdom, that of the *monocotyledonous phænogomous* plants. In describing these bodies, I have expressed my views on their nature. If the opinions of the European authors are right, we have already, from the lower part of the Coal Measures of Illinois, vegetable organisms of a class of plants, whose first appearance has been marked in the Triassic period. Though it may only effect their generic affinity, the presence of these bodies in the concretions of Mazon creek is the more remarkable that they are there associated, as in the Permian of Europe, with a quantity of animal remains, especially insects of large size, which have, as yet, not been discovered elsewhere in the Carboniferous formations.

There has been found in the Coal Measures of England and Nova Scotia, specimens of fossil wood, referable by their tissue, a compound of large woody cells or fibres, marked by vertical circular spots, to the Conifers or Pine family. It is remarkable that most of the fossil wood of our Devonian strata indicates the same characteristic form of cells, and that as yet, neither in Illinois nor in other parts of our true Coal Measures, no kind of branches, leaves, or petrified wood distinctly related to this order of vegetables, have ever been observed. The fragments described from a nodule of Mazon creek in vol. 2, p. 447, pl. xxxvii, fig. 3, of this Report, under the name of *Lycopodites asterophyllitæfolius*, resembles, indeed, a branch of some kind of Conifer, but it is as well comparable to some species of *Lycopodiaceæ*. We have also obtained from the lower strata of the Coal Measures of Illinois and of Pennsylvania, specimens of *Artisia transversa*, Sternb., a species whose affinity is still uncertain, it being considered by Dawson a Conifer, while most of the European palæontologists describe it with the *Lycopodiaceæ*. Our specimens are all transformed into sandstone, with no other part preserved but the mold, do not afford any light on this question. From this uncertainty as to the true affinity of these vegetable remains, and what is said above concerning other orders of fossil plants found in the Carboniferous strata, it would seem proper to conclude that the flora which has furnished the materials for the formation of our coal, and which covered the bogs of our continent at the Carboniferous epoch, was limited to a single group of vegetables, that of the acrogenous cryptogams. (1) The same remarks would seem also to authorize an affirmative answer to the often proposed questions:

---

(1) Prof. Goppert considers the genus *Sigillaria* as rather related to a gymnosperm family. Its relation with the genus *Lepidodendron* is too evident to permit this conclusion; the cones and seeds of *Sigillaria* have moreover been found in our Coal Measures, of the same character as those described by Goldenberg.

1st. Does what we already know of the Coal Measures give us a just idea of the boggy vegetation of which the coal is a compound?

2d. Is the vegetation of the bogs of the coal a true representation of the whole flora of the epoch?

For though it is argued, with an appearance of right, that the whole flora of the Carboniferous time could not have been limited to that of the swamps, that a part of the land was high and dry, and as we have now, on our peat bogs, a peculiar group of plants appropriate to that kind of soil, and without analogy to the vegetation of our dry land, the same differences should have existed at the time of the formation of the coal. The contrary proposition, considered hypothetically, could be equally well sustained. From all appearances, the land, especially on our western coal fields, was, at the Carboniferous period, represented merely by a series of flat swamps, separated by lagoons, and therefore the whole vegetation of the land was essentially of the boggy kind. But, even if at this epoch there was any elevated land, the extreme atmospheric humidity should have forced upon it the same vegetation as that of the bogs, as it happens at our time in some parts of Ireland and Germany, where, under the influence of atmospheric humidity, peat bogs ascend on inclined slopes to the top of high mountains. Prof. Schimper says, in speaking of the ferns which constitute the essential vegetation of the coal formations: there is no other natural order of plants whose intensity of vegetation so much depends upon atmospheric humidity. Ferns are true natural hygrometers, whose individual as well as numerical development is always in direct proportion to the humidity of the climate wherein they live. Therefore, the land vegetation of the Carboniferous period must everywhere bear the same general character. A confirmation of this assertion seems also to be found in the fact, that even in the formations of great thickness of Nova Scotia, where trees are seen standing and imbedded at different altitudes, and where no coal is seen in connection with them, these trees are recognized as belonging to species, or at least to genera of the coal: *Sigillaria*, *Lepidodendron* and *Calamites*. But on the other hand, we have to account for the presence in the slate and sandstone overlying our coal strata, of various kinds of fruits or hard nuts, whose relation, for some of them at least, can not be traced to any species of the coal flora known by other kinds of remains: leaves, stems, etc. It is true that as fast as our acquaintance with this ancient vegetation becomes more intimate, some of these so-called fruits are recognized as peculiar vegetables of the coal, for example, some species of *Trigonocarpum* or *Carpolithes*, as tubercles of *Equisetaceæ*, or as vesicular appendages grown at the end of leaves of *Stigmaria*. But an explanation of this kind can not be admitted for nutlets, representing an internal ovule or seed, covered with three different envelopes like those of *Trigonocarpum Nœggerathii*, of which a fine specimen from Mazon creek has been figured in this Report. They resemble fruit of palms, and have been referred by authors to species of *Cordaites* or *Nœggerathia*. Still less can it be proposed for winged seeds or fruits generally described under the generic name of *Cardiocarpus* and *Rhabdocarpus*. These fruits, whose place in the vegetable kingdom is still problematical to palæontologists, are far better known from American than from European specimens, and their analysis can, therefore, be pursued with chances of more satisfactory results. One of them is described and figured in its whole, in the Arks. Geol. Rept., vol. i, p. 311, pl. 4, fig. 4, as *Cardiocarpus ingens*, Lesqx. Another, still more remarkable, has been published by Dr. Newberry, in the Annals of Science, of Cleveland, May 1853, p. 152, N. 2, as *Cardiocarpus samaræformis*. A third has been obtained in good and numerous specimens from the shale overlaying the coal of Coshocton, Ohio, by Rev. H. Herzer. This peculiar fruit, *Ptilocarpus bicornutus*, Lesqx., (1) is composed of a small oval seed, pointed downwards, rounded or obtuse at the top, obscurely ribbed in the length, attached to the inside of an oval scale, elongated upwards, diverging at its base into two short horns and overlapping the seeds by its border. The seeds, though generally found connected to the winged scales, are easily detached from it, and indeed all the specimens which I have examined, show the seeds already half detached from the top downwards, and to prevent them becoming lost, I had to take them out of the specimens and preserve them separately. This connection of a small oval seed to one side of a winged scale, point out evidently the relation of this fruit and of others related to it, and mark their places as belonging, if not to true Conifers, at least to the Gymnosperm family. However peculiar they may be in their form, though different from seeds of the species of our time, it is scarcely possible to compare them to any other family of vegetables. As the seeds are generally found separate from their scale, a number of fruits of our Coal Measures are probably referable to the new genus, *Carpolithes multistriatus*, for example. For some of the numerous specimens from Colchester, Ill., bear evident remains of scales overlapping the seeds like a broad rim, more or less lacerated and partially destroyed, especially towards the point. And in the nodules of Mazon creek, where these seeds are preserved in their original form, they appear merely tumid in the middle, as compressed under a scale, and not cylindrical. *Rhabdocarpus clavatus* is, perhaps, also a seed of the same kind, as are evidently the species of *Cardiocarpus* published by Dr. Newberry, loc. cit., and many European species like *Rhabdocarpus mammillatus*, *Artis*, etc.

---

(1) As the name indicates, this new genus *Ptilocarpus* is established for the special description of winged fruits having an affinity to those of the Conifers.

I have said above that the relation of these fruits can not be traced to any other kind of vegetable remains, leaves, branches or trunks of the Coal Measures, but there is, I think, a remarkable exception worth mentioning here. The shale overlying the coal of Cuyahoga Falls, Ohio, where *Ptilocarpus samaræformis* has been found with many others of the same genus, is, in some places, covered with a quantity of leaves of the peculiar *Whittleseya elegans*, Newb. These leaves, by their flabellate form, seem related to the genus *Salisburia*, while the nervation resembles that of a *Pterophyllum* or *Zamites*. I consider it very probable that some of the above mentioned winged fruits are related to these leaves, and that we have, therefore, two remarkable organs of species of the Conifer family.

It appears, therefore, that if the Acrogenous plants did constitute the essential part of the vegetation of the Carboniferous epoch, this vegetation had already representatives of the three essential classes of plants of our actual flora: the Phenogamous dicotyledonous, represented by Gymnosperms; the Phenogamous monocotyledonous, to which are referable species of *Cordaites*, *Nœggerathia* and *Trigonocarpum*, and the Cryptogamous, represented by the three families of *Equisetaceæ*, *Filices* and *Lycopodiaceæ*. And from all appearances, we have to admit the similarity of characters and uniformity of the entire flora of the Carboniferous period. For it does not appear that any of the species known from our Coal Measures have been transported from a distance, either by water or by the winds, and casually deposited in sands or clays of the coal swamps. The leaves and fruits are generally found in groups, a number of their remains being together, and covering a limited area, as if originating from trees or plants grown at the place around which these remains are spread, and, as it has been remarked above, all the species of fossil trees as yet examined from the sandstone, are referable to genera known from shale overlying the coal strata.

In pursuing the same mode of investigation, I have still to make some remarks on the affinity of our new species and genera of fossil plants from Illinois, in addition to what has already been said in the detailed description of each. As our table shows, by far the greatest number of our new species have been found in the concretions of Mazon creek, from which it is reasonable to infer that the preservation of many of these species is due to their mode of fossilization, and that the same kind of plants may have been constituents of the vegetation of the coal in other countries, though their remains have not as yet been found elsewhere. Of species of *Neuropteris*, for example, described and figured in the second volume of this Report: *Neuropteris Evenii*, *N. pachyderma* and *N. verbenæfolia*, all from Mazon creek, have been omitted by Schimper in his enumeration; and yet, though the two first have not been elsewhere discovered, their preservation is so remarkable, and their distinctive characters so well marked, that their specific value is beyond question. The case is still more evident with *Neuropteris verbenæfolia*, with which we now have a more intimate acquaintance, from the discovery of a number of specimens, all found at Mazon creek. I mention only these species, not merely as a kind of vindication in favor of our American discoveries, but in order to secure points of comparison in considering the geographical distribution of the plants of the Carboniferous epoch.

No more evident proof of the truth of what is said above could be afforded, than the discovery in the nodules of Mazon creek of numerous specimens of organs, which have as yet scarcely been found elsewhere. The fructification of ferns and their rhizomas, are of this kind. Besides two of the species described in the genus *Staphylopteris*, we have, in nodules from this locality, seven fruiting species of *Alethopteris*, six of *Pecopteris*, with one *Asterocarpus*, most of which were as before unknown in fructifications. And if the fossil fruit-dots of ferns were not generally obscured, and their form and position indistinct, discernible only, as they are, through the substance of the leaves, we should have had for description a far larger number of fruiting specimens of ferns. When Prof. Brongniart published his justly celebrated Fossil Flora (1848), only three species of ferns, *Pecopteris cyathea*, *P. hemiteloides* and *P. Miltoni*, were known and described, with fruiting branches. No fruiting racemes, like those of a *Staphylopteris*, had then, nor have been found even now, after forty years of further researches in the Coal Measures of Europe.

Considering this peculiar scarcity of fruiting ferns, Schimper comes to the conclusion that, as arborescent ferns of our time are rarely fertile, the species of this genus, in the Carboniferous epoch, were mostly fern trees. I should be inclined to admit the same conclusion, especially in considering the number of trunks of ferns, *Caulopteris*, found in the Coal Measures of Illinois, if the coal flora represented in the concretions did not indicate a proportion of fruiting branches nearly as marked as it would be in collecting ferns of our time in a given area.

It is peculiar that, though evidently belonging to herbaceous species of fern, there has not as yet been found any fructification of the genus *Neuropteris*. Leaves of *Neuropteris hirsuta* are the most abundant and the best preserved of all the remains of fossil plants in the nodules of Mazon creek, and yet neither here, nor anywhere else in our Coal Measures, has anything been discovered which might be considered, beyond a doubt, as its fructification. For the intumescence of veins or veinlets, often remarked on the surface of the leaflets of this and other species of *Neuropteris*, and doubtfully considered as produced by groups of fructification placed underneath, seems rather to be the result of some casualty of maceration of the leaves. A mode of fructification of this kind does not agree with that of ferns, and is rather comparable to the *Osmundaceæ* of our time, which bear their fructifications either as separate racemes or on peculiar divisions of their fronds. The fructifications of species of the genus *Odontopteris*, so closely related to *Neuropteris*, are known for *Odontopteris Schlotheimii* and *O. Reichiana*, Gutb. The fertile piunæ, not yet found in connection with sterile fronds, bear inflated, round leaflets resembling small bladders, which have no relation whatever to the intumescence of veins considered as the fructification of *Neuropteris*.

Still more than their fructification, the rhizomas of ferns have hitherto been unknown to palæontologists, at least from the Coal Measures. Prof. Goppert has given, in his Foss. Farnkreuter, p. 91, tab. 33, fig. 1, the only fragment which as yet has been published by European authors, as evidently belonging to true rhizomas of the coal. In his Pal. Veg., Prof. Schimper has published, under the name of *Rhizomopteris*, two fragments of plants, *Selaginites Erdmanni*, Gein., and *Selaginites uncinnatus*, Lesqx., which, from the spiral development of their branches, their ramifications and their scales, he considers as representing small rhizoma of ferns rather than *Lycopodiaceæ*. I cannot agree, on this subject, with my celebrated friend. The plant published as *Selaginites uncinnatus*, Lesqx., vol. ii, p. 446, pl. 41, of this Report, is too slender, and has too slender divisions to represent a rhizoma, even of a climbing fern. Its slender branches, rather pinnately placed, are not more curved in spiral than they may be in some of our species of *Lycopodium*, and the divisions are evidently pinnate, like leaflets, and not scattered like hairs. The plant named *Lycopodites Erdmanni*, by Geinitz, and which, as Prof. Schimper remarks, is different from *L. Erdmanni* of Germ., has, like our *Selaginites crassus*, the ramification and appearance of a *Lycopodium*, but from the examination of peculiar specimens of the same species, seen by the author, it seems to belong to a rhizoma. Even admitting that these two species represent climbing or ærial rhizomas, this small proportion of organs of this kind, compared with the numerous species of ferns known from the Coal Measures of Europe, would be unexplainable, but for our American species. For the concretions of Mazon creek, and only these from the whole extent of our Coal Measures, have furnished us numerous specimens of eight species of these organs, some of them referable to subterraneous rhizomas. It is, therefore, apparent that the organs of the ferns of the Carboniferous epoch were the same, and in the same proportion, as those of our time, but, that some of these, like rhizomas and fruit-bearing fronds, have been more generally destroyed in the shale on account of their soft texture.

The inflated subcylindrical base of a species of *Annularia* and of a *Lepidodendron* are also two remarkable characters, not recognized as yet in the same kind of plants of the Coal Measures, and which we owe still to the peculiar preservation of vegetable remains in the concretions of Illinois. Species of the genus *Annularia* may have been represented in the swamps of the Carboniferous period by two kinds of leaves, according to their growth, either in water or out of it, like some of our actual water plants which have for their sustenance in water peculiar organs, sometimes a mere swelling of their petioles, as in *Trapa natans* for example, which disappear on the emerged parts. A like lubulose, bladdery form characterizes the leaves of the species of *Stigmaria*, whose long stems were sustained by those floating organs, and we could therefore easily admit a dimorphism of the leaves of plants which, like *Annularia*, evidently lived partially in water. But the cylindrical form of the leaves of a *Lepidodendron*, like those of *L. rigens*, cannot be explained in the same manner. These leaves are evidently aerial organs, and by their form expose a new characteristic not yet surmised in species of this genus, though it was already obscurely marked by the position of the vascular lines seen in a different relation, according to the plane in which their leaves have been flattened in shale.

The shales of Morris and Colchester have remains of small branches of a *Lepidodendron*, referable to *L. elegans* or *L. gracile*, Brgt? one to two inches thick, mostly dividing perpendicularly to their axis, bearing short flat leaves, and so abundant that they fill the shale to the thickness of one foot or more, extending and covering a large space. These remains, scarcely varying in thickness, do not look as though pertaining to erect stems, but rather appear like creeping branches, extending all around, like those of some of our species of *Lycopodiaceæ*. The roots of *Lepidodendra* are unknown as yet, and I believe that some species of this genus, heretofore considered as branches of trees, are mere creeping stems, which, in some circumstances, only bear flowering stems, or true *Lepidodendra*. It is the same with the genus *Sigillaria*, the species of which I consider as fruiting stems of *Stigmaria*. It is easily conceivable that large trees, like those of *Lepidodendron* and *Sigillaria*, could not be sustained upon the soft surface of the swamps of the Coal period, without a peculiar kind of support; and this solidifying process of the surface could only be afforded by a vegetation like that of floating or creeping stems of the same kind of plants. Some *Lycopodes* of our time, when growing in swamps, *Lycopodium inundatum* and *L. clavatum* for example, cover the soft ground with their interlaced creeping branches, bearing their rare flowering stems here and there, out of the reach and influence of water. Many aquatic plants of our time also multiply their stems, extending them in every direction by constant division, and fill large basins, even small lakes, never bearing any flowering stem until they have formed, by compact netting, a kind of support strong enough to sustain them out of water for fertilization. This is the case especially with some species of our mosses, *Hypnum Lycopodioides*, *H. fluctans*, *Sphagna*, etc. Some of our species of *Utricularia* have two very distinct modes of vegetation. *U. intermedia*, for example, has, in water, its stems infinitely expanded and divided, sustained as they are by their utricles, while in sand the same species has a simple stem dividing at the base into three branches, true roots which still lower bear a few thread-like filaments, without trace of leaves or utricles. I have compared this kind of vegetation to that of *Sigillaria* of the Coal Measures, merely, of course, for the mode of development.* Remains of *Stigmaria* fill whole banks of fire clay of our Coal Measures, to a thickness of from six to fifty feet, and no remains of *Sigillaria* have ever been found in this clay in connection with them. Prof. Schimper mentions an analogous circumstance from his observation on the Vosges sandstone (*Grauwacke Vosgienne*), whose entire strata are also filled with remains of *Stigmaria*, and where no *Sigillaria* is ever found.† Roots cannot live by themselves, independent of any other kind of organs, and it is certainly impossible to explain the mode of vegetation, the form, the nature of the Stigmaria and its action, in considering it as a root. But admitting these plants to be the floating stems of species of Sigillaria to which they have been sometimes seen attached, their peculiar nature and mode of vegetation becomes explainable, and in circumstances where they are found in the Coal Measures, they are in perfect harmony with the general vegetation of that epoch, as well as with the end which they were called to achieve. As is the case especially with our floating mosses, these floating stems of the Carboniferous epoch have the characters blended in a kind of uniformity which renders them scarcely recognizable. All the *Stigmaria* bear the same kind of cylindrical, bladdery leaves, and therefore have all, though belonging to different species, the same kind of cicatrices upon their stems, viz., a circular, double ring, with a single vascular scar in the center. This peculiarity has been heretofore a problem to palæontologists. Binney has seen *Stigmaria ficoides* as the roots of *Sigillaria reniformis*, Rich. Brown has seen the same *Stigmaria* as the roots of *Sigillaria alternans*. Prof. Goeppert has obtained a splendid specimen of *Sigillaria elongata*, with *Stigmaria* as its roots, and Prof. Schimper has the same *Stigmaria* at the base of a fourth species of *Sigillaria*, and the fossil trees procured by Dr. D. D. Owen, should be quoted still as a fifth species, *S. Owenii*, Lesqx., bearing *Stigmaria* as its basilar appendages. This *Sigillaria* to which I have already alluded, has its mould preserved in perfect integrity with the scars of the stems, those of its base and those of the divisions called roots, fully discernible. The cicatrices of the stem have no affinity with those of any other species of *Sigillaria* hitherto known. They are double, horizontally distant from each other one and one-fourth inches, vertically three-fourths of an inch, formed of two transversly oval scars, close to each other, joined at the corners by a deep line, thus resembling in miniature a pair of spectacles. The small oval scars are about one-eighth of an inch across in their broadest diameter, deeply marked into the stone, formed of an outer ring with crenulate borders, and a comparatively large oval or elongated vascular scar in the middle. The double scars evidently represent the point of attachment of single leaves, which, if they had any analogy of form to that of their base, should have been one-third of an inch broad, with round sub-cylindrical borders, and a broad, flat, medial line. The surface of the trunks is regularly and finely wrinkled in the length: the scars transversely and still more finely so. The cicatrices, in descending towards the base of the tree, gradually change their form. They first become united into one, forming a deep triangular depression, with a single oval scar at the bottom, and further down in reaching the divisions representing their roots, they become round, with a central vascular point, exactly like those of *Stigmaria ficoides*, though a little smaller. The divisions of the stem, at first inclined downwards, become nearly horizontal at the broken extremities, distant twelve inches from the base of the stem. The largest and best preserved of these trunks is, near its base, four to five inches in circumference, dividing there in nine cylindrical branches, the largest ones seven to nine inches in diameter, merely forked near the broken end, which is two to three inches in diameter. The smallest ones, five inches across, are simple. These divisions, though marked with stigmaroid scars, appear indeed like roots, but it is evident that species of *Sigillaria* have sometimes grown in sand, and I believe that, under such circumstances, their subterranean divisions have somewhat modified their form, and hence they become similar to roots, as do the stems of *Utricularia* when they grow in sand. It is to this kind of organs or roots of *Sigillaria*, that the fragments described in this report are referable, under the generic name of *Sigillarioides*.*

---

*W. P. Schimper, Terrain de transition des Vosges, p. 324.

†Prof. Goppert, in his Permain, compares it to that of the Prothalliun of the mosses. There is a mere analogy of division of the branches; nothing more.

From what is said of the relation of *Stigmaria* with *Sigillaria*, it is evident that though the forms of *Stigmaria* are much alike, and generally as yet referred to one species, viz., *S. ficoides*, Brgt., we have indeed as many species of *Stigmaria* as of *Sigillaria*. In his Permian, Prof. Goppert still describes *Stigmaria ficoides* with eleven varieties. I cannot see why differences, though difficult to appreciate, should be considered as specific for one genus and as a mere variation for the other. But botanical palæontology is a peculiar science. It offers to its adepts mere fragments of organs, whose relation to a whole is mostly unknown, forcing him either to generalize, and to consider in one species a number of organs which evidently pertain to plants of various kinds, or to specify and to divide under divers genera and species, fragments which, if not evidently, at least often apparently, belong to the same vegetable. It is not surprising that opinions concerning these remains are often at variance and often modified, or that the student of these fossil remains becomes discouraged by the sterility of his researches. And yet it is to vegetable palæontology mainly that we owe our acquaintance with the surface of our earth at the various epochs. From it we learn the character of the various changes which have modified this surface, and the admirable harmony of all the phenomena produced in its successive modifications. This branch of science has therefore a fascinating attraction, as it opens to our view the treasures of a vegetation that no human eye has ever seen or can expect to see, except in their fossilized fragments, and it shows us that all the divers epochs have been constantly working to the same end: the preparation of a home for the human race; and this work has been constantly pursued in admirable harmony under the direction of a Supreme Intelligence.

---

*I have never had an opportunity of publishing descriptions with plates of these remarkable trees. It may be done hereafter in the report of the Indiana Geological Survey.

§ 6. ON THE STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION OF THE FOSSIL PLANTS OF THE COAL MEASURES.

European palæontologists, who have especially studied the fossil plants of the Carboniferous strata, Brongniart, Goppert, Schimper, Geinitz, etc., have admitted that the distribution of these plants is modified according to the age of each bed of coal, and that, therefore, the horizontal position of the coal strata may be recognized by species peculiar to each. These views, as it now appears, (1) have been advanced on theoretical ground, or are based on local observations which cannot be considered as furnishing conclusive proofs; for local modifications in the succession of species of plants may be the result of mere local atmospherical, or geographical changes, which do not affect the characters of the whole flora, and therefore the comparative distribution of the fossil species of plants of an epoch can not be ascertained, but from the examination of this flora over the whole extent of its domain. A question of this kind can certainly be examined in our country with better chances of a definitive solution, than in any other part of the world, for our coal fields are of vast extent, the disturbances of stratification are rare or uniform, easily recognized by geologists, and the identification of the coal strata is ascertained at different localities from stratigraphical evidence.

From the beginning of my researches, in 1850, on the fossil flora of our Coal Measures, they have been pursued especially in view of obtaining positive data, marking changes in the vegetable constituents of each coal bed, according to its age, and therefore of recognizing species of plants peculiar to each (leading species), which would serve for their identification. As my views on the subject have been published at different times, with the modifications induced by the progress of the researches, a summary of what is positively ascertained as yet on the stratigraphical distribution of the vegetation of the Coal Measures is not out of place in this Report. (1)

---

(1) From the authority of Prof. Brongniart, in letters, 1869.

When researches are restricted to a limited area, or to basins of small extent, marked differences are recognizable in the species of vegetable remains in the shales, as well as in the essential vegetable components of each bed of coal. It is, then, an easy task to ascertain the relative position of the coal strata from the comparison of these remains. But when researches are extended over a wider area, changes of vegetation, evidently caused by geographical distribution, become more and more appreciable, some of the predominant species of a recognized horizon disappearing at some localities, and giving place to others of different characters. A glance at our table of distribution puts this in full evidence. The coal beds of Morris, Colchester and Murphysborough, the two first on the northeastern and northwestern, the last on the southwestern borders of the coal field of Illinois, are recognized, from all evidence, as representing coal No. 2, of the Illinois section, (in vol. 3, p. 6, of this Report) the equivalent of coal 1 B, of the Kentucky Report. (2)

Though the general character of the flora may be considered as the same, we find, by comparison of the species at Murphysborough, eight peculiar species; five only in common with Colchester and Morris, and twelve in common with Morris only, or altogether, eight species proper, and seventeen in common with strata of the same horizon examined elsewhere in Illinois. Colchester and Morris have been more carefully searched for specimens and are nearer to each other. They have seventeen species in common, while Colchester has nine species not yet found at Morris, and Morris has forty-four species, without counting those of Mazon creek, which, as yet, have not been seen at Colchester. The coal of Duquoin, considered as No. 5, of the Illinois section, and the only one from which as yet we have in Illinois and from a higher horizon a number of fossil plants which can be used for comparison, has eleven species proper, and seventeen in common with some or all of the other named localities. Points of difference and identity are therefore as well marked for this bed of coal as if it belonged to the same horizon as the others, and the same differences are observable in the distribution of common or more predominant species. For example, *Neuropteris flexuosa* is most abundant at Murphysborough, and has not as yet been found at Colchester and Morris, where *Pecopteris villosa* and *Callipteris Sullivantii* are the predominant species; and these are but rarely found, or not at all, at Murphysborough. On the contrary, *Pecopteris unita* and *Pecopteris plumosa* are common at Duquoin and Morris, especially in the nodules of Mazon creek, and rare, or not recognized as yet at Colchester and Murphysborough.

---

(1) See, on this subject especially, Penna. Geol. Rept., p. 837; Amer. Jour. of Sci. and Art, Nov. 1860.

(2) All these strata are here marked according to the Illinois section.

From the examination of the table, one may easily see other points of difference between the species found at the same station, or of analogy between those of different horizons. Nevertheless, I am not, on this account, prepared to abandon, as an unsustainable hypothesis, the question of the stratigraphical distribution of the fossil plants of the coal, for the following reasons:

1st. In a theoretical point of view, it is scarcely admissible that at an epoch where the land surface has been universally, and at repeated times, modified by deposits, either of sand or of limestone, sometimes of great thickness, indicating a prolonged submersion, the flora, re-appearing after these terms of subsidence, has always been represented by the same species distributed in the same proportion. Atmospherical circumstances, indeed, are the essential agents in modifying the characters of a flora, and these circumstances have been apparently the same during the whole duration of the Carboniferous epoch. But the elements or components of the soil, or of the water where the plants have lived, have been evidently modified at different times, and even if the medium affording life to the vegetation had been repeatedly the same, some species of plants should have been lost or have somewhat changed their forms in these repeated and prolonged submersions of the whole surface of the coal fields. The destruction, or the first appearance of a species, either animal or vegetable, is the most difficult phenomenon to ascertain. Animal species, for example, seem to appear at once, and of far different kinds, in successive geological strata. But these strata are either composed of different materials, or have been formed in water of various depths, and under other varied circumstances. The changes of life, therefore, are local or casual phenomena, which generally represent a mere displacement of groups, and are of no account whatever in considering the first appearance, or the destruction of a single species.

2d. The fossil plants hitherto obtained from the Coal Measures of Illinois are mainly the result of local researches, too limited to serve as a basis for general conclusions, and it is only after more extended examinations, and more complete collections from other portions of the great area now occupied by Carboniferous strata in this and the adjacent States, that we may expect to obtain the data for determining, in a satisfactory manner, the distribution of the Caboniferous flora over the whole extent of our American coal fields.

3d. When this is done, we shall have sufficient proofs of a gradual change in the characters of the vegetation of the Coal Measures from the first appearance of land vegetation. The *Lycopodiaceous* plants, represented by the genera *Lepidodendron*, *Knorria*, *Ulodendron*, *Sigillaria*, etc., are already represented by large trees in the Devonian of Ohio; in the Upper Silurian and Lower Devonian of Pennsylvania, (1) and occur in abundance in the Chester group (Lower Carboniferous) of Illinois. Representatives of this family of plants become more and more predominant in ascending, and by the number of species, and the size of the trees, the group attains its full development near the base of the true Coal Measures, at the horizon of coal No. 2. The bed of shale overlaying the Sub-Conglomerate coal of Kentucky and Arkansas, appears generally as a compound of mere debris, especially the leaves of *Lepidodendra.* This coal, like that of No. 2, shows also, upon its horizontal layers, distinct remains of plants of the same kind. In Pennsylvania, the shale of the mammoth bed, which I consider as the equivalent of coal 2, is, in places, a compound of large pieces of the bark of *Sigillaria* and *Lepidodendra,* superposed in a thickness of one to two feet, like the leaves of a book. (2) At Cuyahoga Falls, Ohio, the shale of the same coal is, in places, a mere compound also of pieces of bark of *Sigillaria,* and in Illinois, as seen by our table, the remains of *Sigillaria* and *Lepidodendra* predominate in the shale of coal No. 2, and the place of this coal in the sandstone of Marseilles is marked by remains of large trees of the same genera.

Ascending higher in the Measures, the Lycopodiaceous plants decrease in number to coal No. 5, or to the Duquoin coal, which, from its vegetable remains, appears to be the equivalent of coal No. 3. of the Kentucky Reports. This family is here represented still by some species of *Lepidodendron, Lepidophloios,* by cones or *Lepidostrobi* of large size, and by a few *Sigillaria* of the *Lepidodendroid* type, viz.: *Sigillaria sculpta* and *S. Brardei,* which appear to be universal species of the Carboniferous epoch. In higher strata of the Coal Measures of the United States, species of *Lepidodendra* have not as yet been found.

In connection with the Pittsburgh coal, as with coal No. 9 and No· 11, of Kentucky, I have seen specimens of the two last named species of *Sigillaria,* but no remains of *Lepidodendra.* From horizons above the Pittsburgh coal, we know nothing as yet of the flora of our Coal Measures. But in Europe, Goppert, in his flora of the Permian, enumerates *Sigillaria Brardei,* and describes two new species, *S. denudata* and *S. Danziana,* which are nearly related to *Sigillaria sculpta,* Lesqx., if not identical with it. The same work mentions also, as found in the lowest strata of the Permian Measures, *Lepidodendron Veltheimianum,* already present in the Devonian of Europe, and with us in the Lower Carboniferous limestones of Illinois, and with it he describes a few species of cones (*Lepidostrobi*) of diminutive size, indicating there the disappearance of the large Lycopodiaceous plants which afterwards were not represented in any of the formations of our earth.

---

(1) Penn. Geol. Rep., p. 829, fig. 675, 677.

(2) A shale of this kind is, by an abrupt flexure of the coal strata, thrown up near Trevorton, and exposed as a perpendicular wall.

The fruits described under the generic names of *Trigonocarpus*, *Rhabdocarpus*, and *Ptilocarpus*, have as yet been found only from the Sub-Conglomerate coal strata upwards to coal No. 2. They abound in the Millstone grit and the hearth sandstone, as in the shale of coal No. 2. A few fruits of uncertain affinity, and considered under the name of *Carpolithes*, have been observed higher in the Measures; for example, *Carpolithes fasciculatus*, at Grayville, Ills. As yet these cases are very rare.

As to the ferns, the distribution at different horizons is more striking in considering certain groups or races, rather than peculiar genera or species. The genus *Neuropteris*, for example, is equally well represented, from the Sub-Conglomerate coal of Arkansas to the highest strata of Pennsylvania and Kentucky, by *Neuropteris hirsuta*, *Neuropteris flexuosa*, and *Neuropteris Loschii*, all species closely related by their peculiar nervation. These are, moreover, universally distributed over the whole extent of our coal fields, and in Europe two, at least, ascend to the Permian. From this group, *Neuropteris tenuifolia* is the only one which, appearing with the Sub-Conglomerate coal, has not as yet been found higher than coal No. 2. Another section of this genus, especially comprising species of a coarse or thick nervation or texture, like *Neuropteris Clarksonii*, *N. rarinervis*, *N. vermicularis*, *N. coriacea*, *N. pachyderma*, etc., is as yet truly characteristic of coal No. 2, none of them having as yet been found above or below it. All the species of the genus *Odontopteris* appear distributed from the coal strata under the Millstone grit up to coal No. 1 and No. 2. In Illinois, as in Pennsylvania, most of the species are found in connection with the last bed. It is the same with the species of large, thick leaved *Alethopteris*, *A. lonchitica*, *A. Serlii*, *A. Mazoniana*, *A. Massillonis*, *A. Owenii*, etc. They form, with *Callipteris Sullivantii*, a distinct and peculiar group, which may be considered truly characteristic of coal No. 2. *Alethopteris lonchitica*, has always been for me an essential leading species, and never, as yet, has misled me as marking the horizon of the mammoth vein of Penna. In the east, it is a most common species; it abounds also at Cuyahoga Falls, Ohio; but it seems to disappear in some basins, as for example in Illinois, where its place is taken by *Alethopteris Serlii* and *Callipteris Sullivantii*.

Of *Pecopteris*, the section which Brongniart separates under the name of *Sphenopteroides*, and which Schimper rightly places in the genus *Sphenopteris*, is the only one which may be considered as yet as peculiar to the lower Coal Measures. Its species, *Pecopteris Murrayana*, *P. chærophylloides*, *P. Newberryi*, with *Sphenopteris latifolia*, *S. obtusiloba*, and *S. acuta*, are found in connection with coal No. 2. *Hymenophyllites furcatus* has more generally been found below the Millstone grit, but it ascends, though rarely, to coal No. 2, where also *Hymenophyllites splendens*, *H. Schlotheimii* and some other species of the section *Aphlebia* are generally found.

As representative of the higher coal strata of Illinois, or of coal No. 5, there is no particular species to quote. *Alethopteris aquilina*, with *Pecopteris unita*, *P. plumosa*, *Cordaites angustifolia*, and species of *Lepidophloios*, are there represented by more abundant specimens than anywhere else, but remains of these plants have been also observed in the lower Coal Measures. In the anthracite basin of Pennsylvania, the highest strata are recognized by the presence of *Pecopteris arborescens*, which has not been as yet positively discovered in Illinois, the small specimens referred to it from a nodule of Mazon creek being too obscure for certain identification. This species, the most abundant of all in some localities of Pennsylvania, is found also in profusion in the red clay beds of Ohio, especially in the *grotto of flowers*, near Marietta, where it is represented by a slightly different form, perhaps a mere variety of *P. rubra*, Lesqx. In Europe, it ascends to the Permian, where its characters, though somewhat modified, have been considered as specific by Goppert, who has named it *P.* (*Cyatheites*) *Schlotheimii*. It is there, as with us, associated with its large form *P. Cyathea*, Brgt. The section *Cyatheites* of the genus *Pecopteris*, is, indeed, of all the fossil ferns of the coal, the one which is, in some of its species, characteristic of the higher coal strata. But as yet these species are indifferently known, and therefore it is hardly possible to indicate them as peculiar to a certain horizon. For example, *Pecopteris polymorpha*, Brgt., abounds in the highest coal strata of Illinois at Grayville, and near New Harmony, Ind. It is generally like *P. arborescens*, a marked species of our upper Coal Measures, while *Pecopteris abbreviata*, which Prof. Geinitz takes as a mere variety of it, is common at Morris, Mazon creek and other places, always in connection with coal No. 2, and has not yet been observed in higher strata. The differences in these horizons, as well as in the form of the pinnæ, indicate these remains as representing two different species, though the nervation is of the same kind. It is certain that, as the Lycopodiaceous plants of the coal decrease in the number of their representatives, as in their size, in ascending in the Coal Measures, they are proportionally replaced by ferns, either herbaceous or arborescent. This change is everywhere evident in the shale overlaying the coal beds, as in the coal itself. At Grayville, and especially at Springfield, Ill., where the upper coal is nearly 200 feet above coal No. 5, the lamellæ of the coal bear a quantity of recognizable leaflets and branches of ferns, especially of the genus *Pecopteris*. The roof shales of the Pomroy coal in Ohio are thickly covered with remains of ferns, especially large pinnæ, still bearing leaves of *Neuropteris flexuosa* and *N. hirsuta*. A bed of shale, which in places underlies the Pittsburg coal, is also a mere compound of stems and leaves of this last species, and I have received from the highest coal bed of Kansas, which is considered by some geologists as belonging to the Permian strata, a large lot of specimens of the roof shale, which, like those from under the Pittsburg coal, contain leaves of the same *Neuropteris hirsuta* heaped in profusion, without any other species but *N. Loschii.*

From the horizon of the Pittsburg coal, we have from Pennsylvania two remarkable species, whose discovery is due to the sagacious investigation of Rev. D. C. Moore, and which, by their characters, appear related rather to species of the Permian, or even of the Oolite, than to those of the Carboniferous epoch. One is the peculiar *Neuropteris Moorii*, Lesqx., Penn. Geol. Rept., p. 860, Pl. xix, fig. 1,* related by the pointed form of its leaflets and their size to *Pecopteris Whitbiensis*, Ll. and Hutt., of the Oolite of England. The second is apparently a species of *Schizoneura*, a new genus of Schimper, represented as yet by only four species in the Trias and the Oolite of Europe. Our species is known only by small branches, one-fourth of an inch broad, striated lengthwise, like those of a *Sphenophyllum*, articulated at short distances, bearing at the articulations whorls of ten to twelve oblanceolate obtuse flat leaflets, about one inch long, marked lengthwise by parallel thin veinlets. These leaflets appear distinct or unconnected to their base, which is marked by small, circular, distinct scars. No trace of a vagina has been observed as yet.

The presence of these peculiar plants in the higher Coal Measures of Pennsylvania may not be more conclusive, as indicating a distinct geological horizon, than are the numerous remains of insects, crustaceans, etc., discovered in the nodules of Mazon creek, and which have as yet their relatives only represented in the Permian. But I desire to make here only a record of facts, according to our actual knowledge, in regard to the flora of the Coal Measures, and leave to future discoverers the task of obtaining more reliable data for a definitive conclusion on the subject.

The examination of the geographical distribution of the flora of our Carboniferous strata, according to the suggestions of Prof. H. D. Rogers, in the preparation of the Pennsylvania Geological Report, proposes the solution of these three questions: 1st. What is the geological relation of our Coal Measures with those of Europe, in considering the vegetable constituents of the strata in both continents? 2d. From the same kind of researches, is the anthracite basin of Pennsylvania identical in its age and in the distribution of its measures with the great Apalachian bituminous coal basin of Ohio and Pennsylvania? And as a corollary: 3d. What is the geological relation of the sepa-

---

*Prof. W. P. Schimper has separated this species as the type of a new genus *Lescuropteris*, a separation already indicated by my remarks with the description of this species, loc. cit.

rate coal basins of Western Kentucky, Illinois and Michigan with our eastern coal fields? The first two of these questions have been examined and answered in the Geological Report of Pennsylvania, pp. 839–842. Though new discoveries might now furnish some interesting details to the discussion, nothing has as yet been found in the Coal Measures, which might tend to invalidate the conclusions admitted in that report. The third question has been also considered* from data obtained in the geological explorations of Kentucky, Arkansas and Indiana, and therefore I have but to add here a few remarks which are called for by the species recently found in the Coal Measures of Illinois.

We cannot expect to trace any marked differences indicating climatic divisions from the northern to the southern limits of the coal fields of Illinois. Local changes, as indicated from the table of distribution, can but be considered as casual, and not ascribed to any permanent or general thermal influence.

The relation of the Coal Measures of Illinois with the eastern coal fields of Pennsylvania, Rhode Island and Nova Scotia, is indicated not only by the common or more predominant species, but also by some rare and striking ones. The coal of Morris, for example, has, in common with that of Newport, R. I., *Pecopteris squamosa*, *Pecopteris unita*, *Odontopteris Schlotheimii* and *Asterophyllites lævis;* with the low beds of anthracite of Pennsylvania, *Callipteris Sullivantii*, *Neuropteris fimbriata*, *N. rarinervis*, *N. Clarksonii*, *N. Desorii*, etc., and with the Coal Measures of Nova Scotia: *Odontopteris subcuneata*, a species not seen as yet in any other part of the coal fields of the United States. Some species of the eastern basin, like *Neuropteris Rogersi*, Lesqx., *Odontopteris alata*, Lesqx., *Alethopteris obscura*, Lesqx., *Whittleseya elegans* ,Newb.,etc., have not yet been found in Illinois; but these are very rare species, discovered each at a single locality, as are some of the new species described from the coal fields of Illinois, and which may be found elsewhere hereafter. Illinois has likewise about 30 species known in the coal flora of Europe, and which have not been yet seen in the more eastern coal fields of America.

Of the common species of our eastern coal fields, not yet found in Illinois, none can be quoted but *Dictyopteris obliqua*, Bunb., locally abundant in the shale of the high coal near Pottsville, Penn., of Newport, R. I., and of the subconglomerate coal of Arkansas; *Sphenopteris artemisiæfolia*, Brgt., rare everywhere, sparingly found in the low beds of the anthracite basin of Pennsylvania and of the western coal fields of Kentucky; *Pecopteris arborescens*, already quoted; *Pecopteris Loschii* and the peculiar *Brachyphyllum obtusum*, Lesqx., both locally predominant in the anthracite fields. The near relation of the coal basin of Illinois with the other coal fields of this continent, is thus demonstrated by its fossil flora.

---

*Journal of Science and Art, July, 1860.

The number of European species recognized in the Coal Measures of Illinois do not change in any way the relation of the American Coal Measures with those of Europe. It remains now the same as I have presented it formerly (Penn. Geol. Rep., loc. cit.). If general affinity is ascertained by a large number of plants, either identical or closely related, geographical differences in the vegetation are indicated by peculiar species or races of ours, which as yet have not been observed in the Coal Measures of Europe. It is true that European palæontologists, though at work on the coal flora for more than a century, still discover species, either identical with or allied to some of ours, which were once considered as exclusively pertaining to the American coal flora; for example, a fimbriate *Cyclopteris*[*] from a small anthracite basin of the Swiss Alpine mountains. But these cases are very rare indeed, and besides what is known from other parts of our coal fields, Illinois has now furnished a number of these peculiar types of vegetables, which render geographical disparity more appreciable. Of this kind are especially *Neuropteris verbenæfolia*, *N. Evenii*, *N. pachyderma*, *Dictyopteris rubella*, *Alethopteris hymenophylloides*, *A. inflata*, *A. solida*, *Pecopteris Strongii*, species of *Staphylopteris*, *Sphenopteris scaberrima*, *Hymenophyllites mollis*, *Schutzia bracteata*, a number of species of *Lepidodendra* and *Sigillaria*, *Syringodendron Porteri*, *Megaphytum McLayii*, species of *Caulopteris* and of fruits of *Palæoxyris*. Indeed, no genus of our coal flora, except, perhaps, *Calamites*, can be considered as represented on both continents by species all identical or closely allied. As these points of difference, like those of affinity, have been observed from the beginning of the researches on the coal flora, and have not varied much in comparative quantity, they appear to fully corroborate the statement that, at the Carboniferous epoch, the flora which formed the constituents of the coal, was in Europe and in the United States as different, and at the same time as relatively alike, as is now the flora of the peat bogs of the two continents.

---

[*] *Cyclopteris lacerata*, Heer., see descriptive part. The predominant species of this Alpine basin, which was for a long time considered as of a different formation from that of the Carboniferous epoch, is *Odontopteris Alpina*, Brgt., a peculiar plant, which, as yet, with us, has been found only in connection with the anthracite of Rhode Island.

INDEX.

PAGE.
Adams county, geology of.............. 43
Adams county, Quaternary system in..... 44
Adams county, Coal Measures in........ 48
Adams county, St. Louis limestone in .. 51
Adams county, Keokuk limestone in..... 53
Adams county, Burlington limestone in.. 55
Adams county, Kinderhook group in..... 57
Adams county, economical geology of.... 58
Adams county, soil and timber in....... 60
Alethopteris.............................391
Alethopteris crenulata.................392
Alethopteris cristata...................395
Alethopteris erosa......................394
Alethopteris emarginata.................398
Alethopteris falcata....................396
Alethopteris Hallii.....................394
Alethopteris Hymenophylloides..........393
Alethopteris longifolia.................469
Alethopteris lanceolata.................398
Alethopteris Mazoniana.................391
Alethopteris muricata...................395
Alethopteris Pluckneti..................395
Alethopteris Pennsylvaniaca............469
Alethopteris solida.....................397
Alethopteris spinulosa..................396
Amblipterus macropterus................348
Annularia inflata.......................423
Annularia longifolia....................422
Antliodus sarcululus....................356
Aphlebia....................410 and 414
Asterocarpus grandis...................469
Asteroptychius triangularis............370
Asterophyllites grandis.................424
Asterophyllites foliosus................424
Asterophyllites rigidus.................424
Asterophyllites tuberculatus...........424

Brown county, geology of.............. 62
Brown county, Quaternary system in..... 63

PAGE.
Brown county, Coal Measures in......... 65
Brown county, St. Louis limestone in.... 68
Brown county, Keokuk group in......... 69
Brown county, economical geology of.... 70
Brown county, soil and agriculture...... 73

Callipteris Sullivantii..................468
Carpolithes bullatus....................463
Carpolithes corticosus..................462
Carpolithes persicaria..................462
Cass and Menard counties, geology of... 163
Cass and Menard counties, Coal Measures in..............................165
Cass and Menard counties, economical geology of...........................173
Calhoun county, geology of.............. 1
Calhoun county, St. Peters sandstone in.. 3
Calhoun county, Trenton group in....... 4
Calhoun county, Cincinnati group in..... 5
Calhoun county, Niagara limestone in.... 6
Calhoun county, Hamilton group in...... 8
Calhoun county, Kinderhook group in.... 9
Calhoun county, Burlington limestone in. 12
Calhoun county, Keokuk limestone in.... 14
Calhoun county, St. Louis limestone in... 15
Calhoun county, Coal Measures in....... 15
Calhoun county, Quaternary system in.... 17
Calhoun county, economical geology of... 18
Calhoun county, soil and agriculture of.. 22
Cap au Gres, fault.................... 2
Caulopteris acantophora................458
Caulopteris intermedia..................459
Caulopteris obtecta.....................457
Champaign and Ford counties, geology of..272
Chondrites Colletti.....................379
Coal, analyses of..33, 50, 53, 85, 86, 104, 105, 257, 259, 316
Coal shaft, Jacksonville................159
Coal shaft, Bloomington.................186

PAGE.
Coal shaft, Braidwood....................213
Coal shaft, Martin's, Mercer county.. ...303
Coal shaft, Bradford, Stark county.......327
Coal shaft, S. C. Francis', Stark county..326
Coal shaft, Metamora....................337
Coal shaft, Minonk................. ...338
Cladodus deflexus....................355
Cladodus elegans....................354
Cladodus ischypus....................354
Cochliodus costatus....................364
Cordaites angustifolia....................420
Ctenacanthus Mayi....... 372
Cymatodus....................363
Cymatodus oblongus........ 364

DeKalb, Kane and Dupage counties, geology of 111
DeKalb, Kane and DuPage counties, artesian well in....................114
DeKalb, Kane and DuPage counties, Niagara group in....................114
DeKalb, Kane and DuPage counties, Cincinnati group in....................121
DeKalb, Kane and DuPage counties, Trenton group in....................122
DeKalb, Kane and DuPage counties, economical geology of....................123
Deltodus alatus....................368
Deltodus angustus......... 368
Deltodus fasciatus........ 366
Deltodus Littoni....................367
Dictyopteris....................388
Dictyopteris rubella....................388

Edestus Heinrichsii....................350
Edestus vorax............... ... .350
Edgar county, geology of....................266
Edgar county, section of rocks in.......267
Equisetites....................425
Equisetites occidentalis 425

Fossil fishes, remarks on..............345
Fossil plants....................377
Fossil plants, distribution of...........500
Fossil plants, list of....................471
Fossil plants, preserved in coal 478
Fossil plants, preserved in shale........479
Fossil plants, preserved in concretions...481
Fossil plants, preserved by mineralization.488
Fossil plants, affinities of..............489

PAGE.
Fulton county, geology of.............. 90
Fulton county, Coal Measures in........ 93
Fulton county, conglomerate in.........102
Fulton county, St. Louis limestone in....103
Fulton county, economical geology of....103
Fulton county, list of trees in... 109

Grundy county, geology of..............190
Grundy county, Post Tertiary beds in.. ..191
Grundy county, Coal Measures in.........194
Grundy county, Cincinnati group in.....200
Grundy county, Trenton limestone in....201
Grundy county, St. Peters sandstone in...201
Grundy county, economical geology of...202
Grundy county, artesian wells in........205

Halonia.................... 450
Halonia tuberculata....................451
Helodus compressus....................360
Helodus rugosus........ .... .359
Henderson county, geology of...........276
Henderson county, Coal Measures in.....278
Henderson county, Keokuk group in.... 279
Henderson county, Burlington limestone in281
Henderson county, Kinderhook group in..285
Henderson county, economical geology of.286
Hydraulic limestone. 40, 205
Hymenophyllites....................410
Hymenophyllites alatus... 411
Hymenophyllites adnascens 414
Hymenophyllites arborescens............415
Hymenophyllites Clarkii................416
Hymenophyllites delicatulus.... 412
Hymenophyllites furcatus..............470
Hymenophyllites Gutbierianus...........416
Hymenophyllites inflatus.......... ..414
Hymenophyllites lactuca.... 415
Hymenophyllites mollis................418
Hymenophyllites myriophyllum.........412
Hymenophyllites Schlotheimii...........412
Hymenophyllites splendens..............413
Hymenophyllites Strongii..... ... .417
Hymenophyllites tenuifolius.... 413
Hymenophyllites thallyformis...........417
Hymenophyllites trichomanoides........411
Hymenophyllites tridactylites...........411

Iron ore......21, 87, 106, 174, 223, 235, 262
Iron ore, analyses of.................. 87

Kankakee and Iroquois counties, geology of.226
Kankakee and Iroquois counties, Drift in..229

PAGE.
Kankakee and Iroquois counties, Coal Measures in....231
Kankakee and Iroquois counties, Niagara limestone in....232
Kankakee and Iroquois counties, Cincinnati group in....233
Kankakee and Iroquois counties, economical geology of....234
Kankakee and Iroquois counties, ancient valley in....237
Kendall county, geology of....136
Kendall county, Coal Measures in....138
Kendall county, Niagara group in....139
Kendall county, Trenton limestone in....143
Kendall county, St. Peters sandstone in....146
Kendall county, economical geology of....147
Knorria....445
Knox county, geology of....313
Knox county, Coal Measures in....314
Knox county, economical geology of....322

Lepidodendron....428
Lepidodendron cruciatum....432
Lepidodendron elegans....433
Lepidodendron forulatum....431
Lepidodendron gracile....433
Lepidodendron Greenii....433
Lepidodendron modulatum....430
Lepidodendron Morrisianum....430
Lepidodendron mammillatum....432
Lepidodendron rigens....429
Lepidodendron Tijoui....431
Lepidophloios auriculatum....439
Lepidophloios laricinum....440
Lepidophloios protuberans....440
Lepidostrobus....440
Lepidostrobus connivens....442
Lepidostrobus lancifolius....442
Lepidostrobus oblongifolius....441
Lepidostrobus ornatus....443
Lepidostrobus ovatifolius....441
Lepidostrobus truncatus....442
Lepidophyllum foliaceum....444
Lepidophyllum rostellatum....443
Lepidophyllum striatum....443
Listracanthus....371
Listracanthus hystrix....372
Lophodus....360
Lophodus variabilis....361
Lycopodites annulariæfolius....426
Lycopodites Meekii....426

PAGE.
McHenry and Lake counties, geology of....126
McHenry and Lake counties, Drift deposits in....129
McHenry and Lake counties, Niagara group in....131
McHenry and Lake counties, Cincinnati group in....132
McHenry and Lake counties, economical geology of....133
Mercer county, geology of....301
Mercer county, Loess and Drift in....302
Mercer county, Coal Measures in....302
Mercer county, Kinderhook group in....307
Mercer county, economical geology of....307
Mercer county, soil and agriculture of....311
Morgan county, geology of....149
Morgan county, Coal Measures in....151
Morgan county, St. Louis limestone in....160
Morgan county, economical geology of....161

Neuropteris....380
Neuropteris angustifolia....467
Neuropteris capitata....383
Neuropteris Collinsi....382
Neuropteris coriacea....387
Neuropteris crenulata....468
Neuropteris fimbriata....384
Neuropteris fasciculata....381
Neuropteris hirsuta....380
Neuropteris inflata....387
Neuropteris microphylla....467
Neuropteris rarinervis....386
Neuropteris verbenæfolia....385
Neuropteris vermicularis....385

Odontopteris Bradleyi....390
Odontopteris Schlotheimii....391
Odontopteris subcuneata....390
Orodus corrugatus....358

Pachypteris....419
Pachypteris gracillima....419
Palæoniscus gracilis....347
Palæoxyris....464
Palæoxyris appendiculata....465
Palæoxyris corrugata....466
Palæoxyris Prendeli....464
Peat, deposits of....124, 134, 148
Pecopteris abbreviata....403
Pecopteris arguta....402
Pecopteris aspidioides....403
Pecopteris Bucklandi....401

PAGE.
Pecopteris chœrophylloides............404
Pecopteris dentata....................404
Pecopteris elegans....................403
Pecopteris flavicans..................404
Pecopteris hemiteloides...............401
Pecopteris villosa....................402
Peltodus..............................362
Peltodus unguiformis..................363
Petalodus curtus......................355
Petrodus pustulosus...................369
Physonemus gigas......................378
Pike county, geology of................ 24
Pike county, Niagara limestone in...... 26
Pike county, Kinderhook group in....... 27
Pike county, Burlington limestone in.... 29
Pike county, Keokuk group in........... 31
Pike county, St. Louis group in......... 32
Pike county, Coal Measures in.......... 32
Pike county, Quaternary system in...... 35
Pike county, economical geology of...... 37
Platysomus circularis.................347
Pœcilodus convolutus..................366
Polyrhizodus Littoni..................357
Polyrhizodus truncatus................357
Potters' clay....60, 71, 86, 162, 204, 221, 262

Rhabdocarpus..........................461
Rhabdocarpus clavatus.................461
Rhabdocarpus mammillatus..............461
Rizodus reticulatus...................349
Riuodus...............................374

Sandalodus crassus....................369
Schizopteris.....................411, 418
Schutzia..............................427
Schutzia bracteata....................427
Schuyler county, geology of............ 75
Schuyler county, Quaternary system in... 76
Schuyler county, Coal Measures in....... 77
Schuyler county, St. Louis group in..... 84
Schuyler county, Keokuk group in....... 84
Schuyler county, economical geology of... 85
Sigillariæ semina.....................463
Sigillaria alternans..................447
Sigillaria Cistii......................447
Sigillaria corrugata...................445
Sigillaria Massiliensis...............446
Sigillaria spinulosa..................447
Sigillarioides........................449
Sigillarioides radicans...............449
Sigillarioides stellaris..............450

PAGE.
Sphenopteris elegans..................410
Sphenopteris gracilis.................408
Sphenopteris mixta....................409
Sphenopteris scaberrima...............408
Sphenopteris trifoliata...............410
Sphenophyllum cornutum................421
Sphenophyllum filiculmis..............422
Springs, mineral...........22, 89, 148, 189
Springs, Perry......................... 40
Springs, Versailles.................... 73
Staphylopteris........................405
Staphylopteris asteroides.............406
Staphylopteris sagittatus.............407
Staphylopteris Wortheni...............405
Stark county, geology of..............325
Stark county, Quaternary deposits in.....325
Stark county, Coal Measures in........326
Stark county, economical geology of. ...330
Stark county, soil and agriculture of... .333
Stigmaria elliptica...................451
Stigmaria umbonata....................452
Stigmarioides.........................452
Stigmarioides affinis.................455
Stigmarioides linearis................455
Stigmarioides selago..................456
Stigmarioides truncatus...............453
Stigmarioides villosus................454
Stigmarioides? rugosus................470
Syringodendron cyclostigma............449
Syringodendron pes-capreoli........... 448
Syringodendron Porteri................448

Tazewell, McLean, Logan and Mason counties, geology of......................176
Tazewell, McLean, Logan and Mason counties, boundaries of..................176
Tazewell, McLean, Logan and Mason counties, geological formations in.........177
Tazewell, McLean, Logan and Mason counties, Drift section of................178
Tazewell, McLean, Logan and Mason counties, Coal Measures in................179
Tazewell, McLean, Logan and Mason counties, economical geology of...........187
Trigonocarpum nœggerathii.............460
Trigonocarpum olivæformis.............460

Ulodendron............................434
Ulodendron elongatum..................437
Ulodendron ellipticum.................436
Ulodendron majus......................435

PAGE.
Ulodendron punctatum................438

Vermilion county, geology of..........241
Vermilion county, Loess in...........242
Vermilion county, Drift in.............242
Vermilion county, Coal Measures in.....244
Vermilion county, economical geology of.255

Warren county, geology of.............288
Warren county, Coal Measures in...... 289
Warren county, Burlington limestone in..295
Warren county, Kinderhook group in ...297
Warren county, economical geology of...298

PAGE.
Will county, geology of................207
Will county, Quaternary beds in.........208
Will county, Coal Measures in..........209
Will county, Niagara limestone in.......213
Will county, Cincinnati group in........216
Will county, general section of beds in...219
Will county, economical geology of.....219
Will county, comparison of levels in.....224
Woodford county, geology of............334
Woodford county, Loess and Drift in.....335
Woodford county, Coal Measures in 337
Woodford county, economical geology of..340
Woodford county, soil and agriculture of..341

ERRATA.

Page 22, 15th line from bottom, for "old" read older.
Page 90, 15th line from bottom, for "positions" read portions.
Page 97, 16th line from top, for "southeast" read southwest.
Page 109, 15th line from bottom, for "Cophalanthus" read Cephalanthus.
Page 110, 10th line from top, for "eriocephala" read criocephala.
Page 120, 11th line from bottom, for "gasterapod" read gasteropod.
Page 136, 8th line from top, for "three" read these
Page 168, 12th line from bottom, for "Roissi" read Royssii.
Page 184, 16th line from top, for "exactneas" read exactness.
Page 195, 8th line from top, for "Crustaceon" read Crustacean.
Page 195, 18th line from bottom, for "Morgan" read Mazon.
Page 201, 16th line from top, for "fossil" read fossils.
Page 222, 18th line from top, for "oxide" read oxyd.
Page 233, 3d line from top, for "ara" read are.
Page 251, 20th line from top, for "is quite it" read it is quite.
Page 319, 19th line from top, for "Geineitzii" read Geinitzii.
Page 336, 10th line from bottom, for "Tamarach" read Tamarack.
Page 350, 10th line from top, for "enamelled" read enameled.
Page 353, 11th line from bottom, for "bitumization" read bituminization.
Page 356, 5th line from top, for "bevelled" read beveled.
Page 359, 1st line, for "are" read one.
Page 360, 15th line from top, and 361, 4th line from bottom, for "bevelled" read beveled.
Page 361, bottom line, for "enamelled" read enameled.
Page 386, 13th line from bottom, for "diversions" read divisions.
Page 389, 6th line from bottom, and bottom line, for "Brongnarti" read Brongniartii.
Page 399, 7th line from bottom, for "coreaceous" read coriaceous.
Page 403, 6th line from bottom, for "Versteinerimgen" read Versteinerungen.
Page 409, 2d line from bottom, for "Sphenotopteris" read Sphenopteris.
Page 438, 5th line from top, for "Syrigodendron" read Syringodendron.
Page 456, 2d line from bottom, for "Phizomopteris Rrdmani" read Rhizomopteris Erdmanni.

PLATE I.

		PAGE.
Fig. 1.	EDESTUS HENREICHSII, N. and W	350
1 *a.*	Side view, two-thirds natural size.	
1 *b.*	Section of the same, one-half natural size.	
Fig. 2.	EDESTUS VORAX, Leidy	350
	Side view of specimen, natural size.	

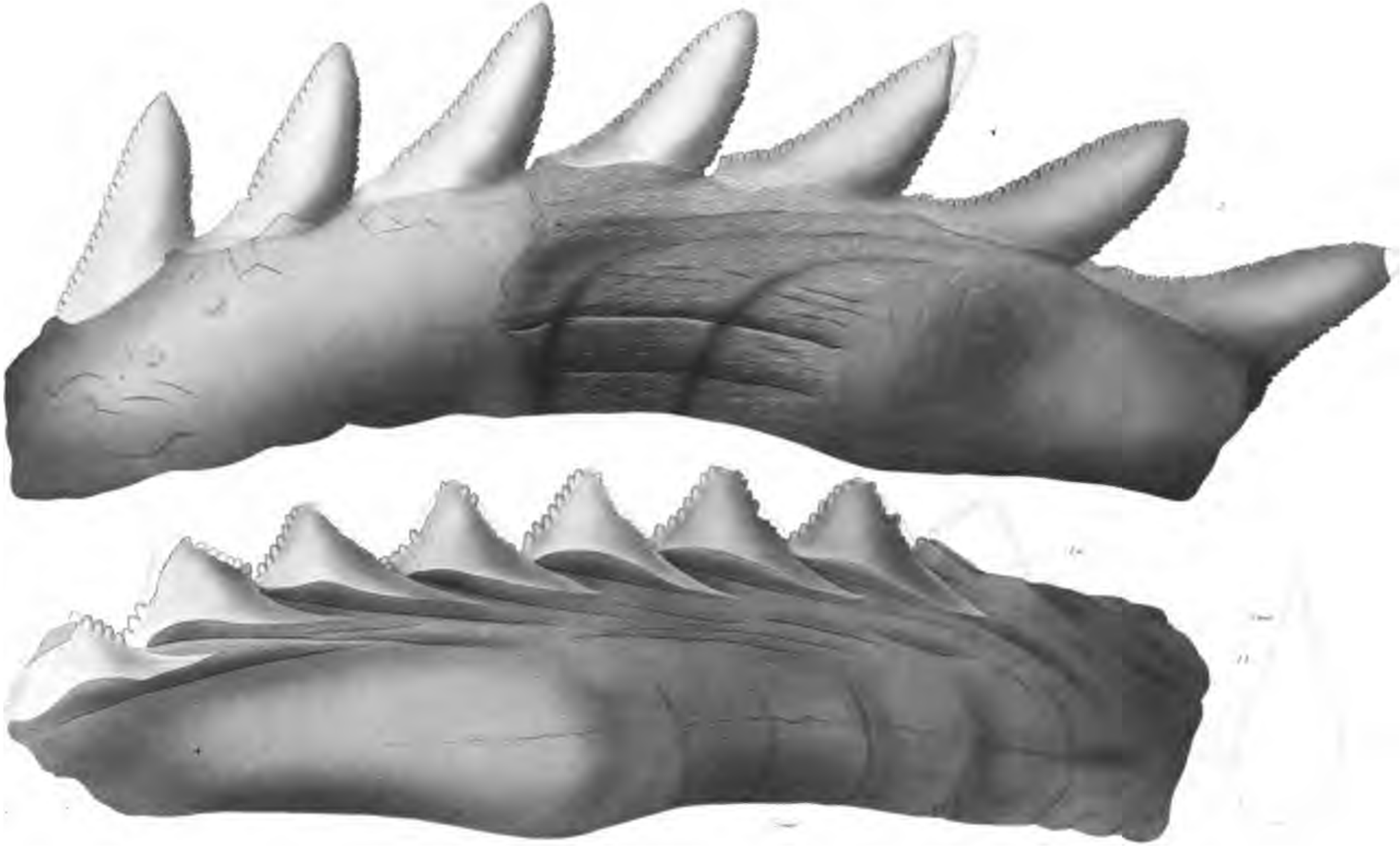


PLATE II.

Page.

Fig. 1. PHYSONEMUS GIGAS, N. and W. 373
1. Lateral view of spine, natural size.
1 *a*. One of the anterior tubercles enlarged.

Fig. 2. CTENACANTHUS MAYI, N. and W. 372
2. View of a specimen of large size, imperfect at the base.
2 *a*. Section of the same.

Fig. 3. LISTRACANTHUS HYSTRIX, N and W. 372
3. A very large specimen, natural size.
3 *a*. View of a very small specimen.

Fig. 4. ASTEROPTYCHIUS TRIANGULARIS, N. and W. 370
4. Lateral surface of a specimen of medium size, imperfect at base and apex.

Fig. 5. PETRODUS ? PUSTULOSUS, N. and W. 369
5. Upper surface of a very large specimen.
5 *a*. Profile of the same.

Fig. 6. DELTODUS ALATUS, N. and W. 368
Superior surface of a large specimen, natural size.

Fig. 7. PELTODUS UNGUIFORMIS, N. and W. 363
7. View of the basal and anterior crown surface.
7 *a*. Profile of the same.

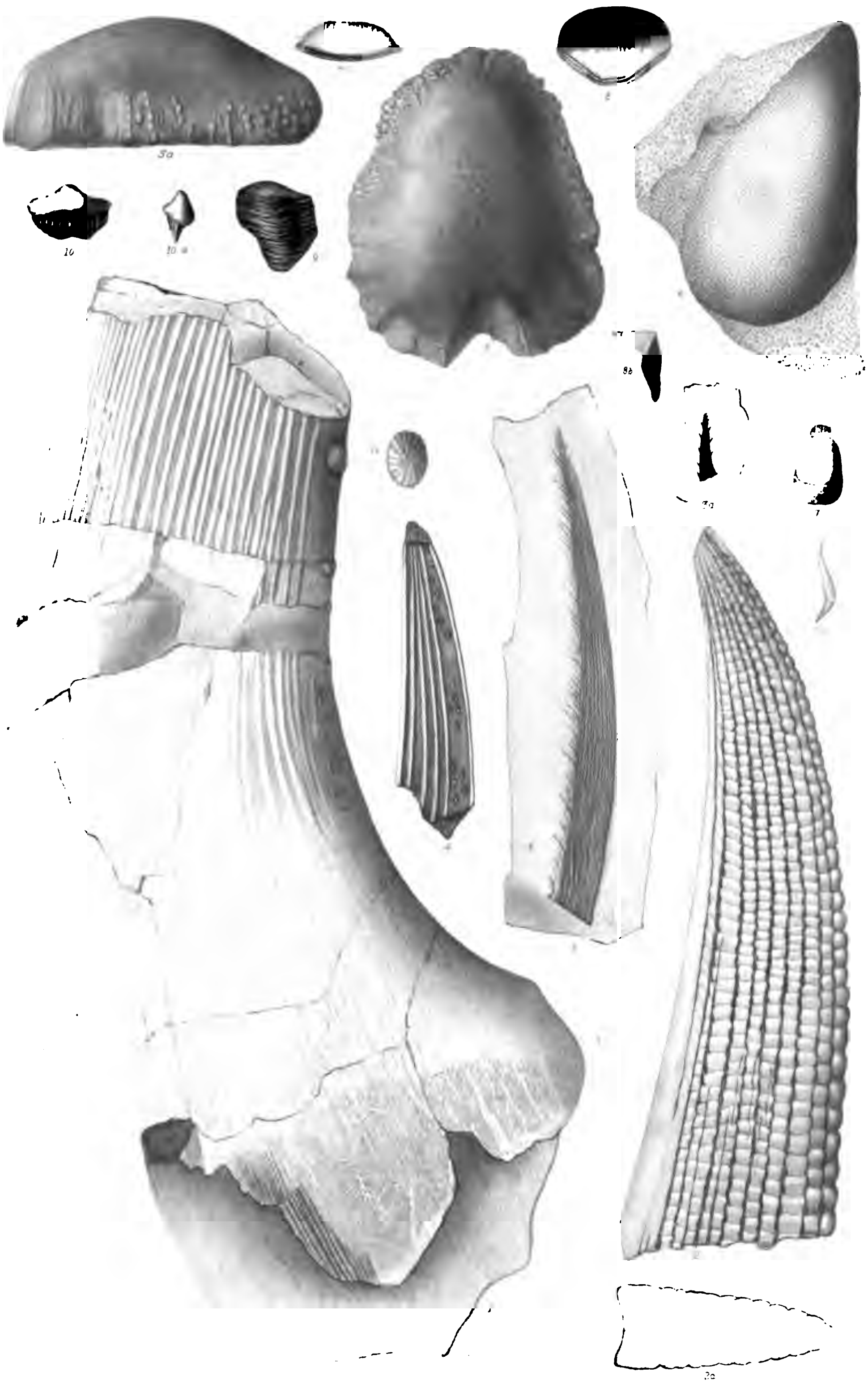
Fig. 8. ANTLIODUS SARCULULUS, N. and W. 356
8. Posterior face, natural size.
8 *a*, 8 *b*. Anterior face, and profile of the same.

Fig. 9 PŒCILODUS CONVOLUTUS, N. and W. 366
View of superior surface, natural size.

Fig. 10. HELODUS RUGOSUS, N. and W. 359
10. Posterior face of specimen, natural size.
10 *a*. Profile of the same.

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS (Coal Measures & Lower Carb. Limestone) FISHES



Chas. K. Worthen del. A. H. Worthen direxit Western Engraving Co. Chicago

PLATE III.

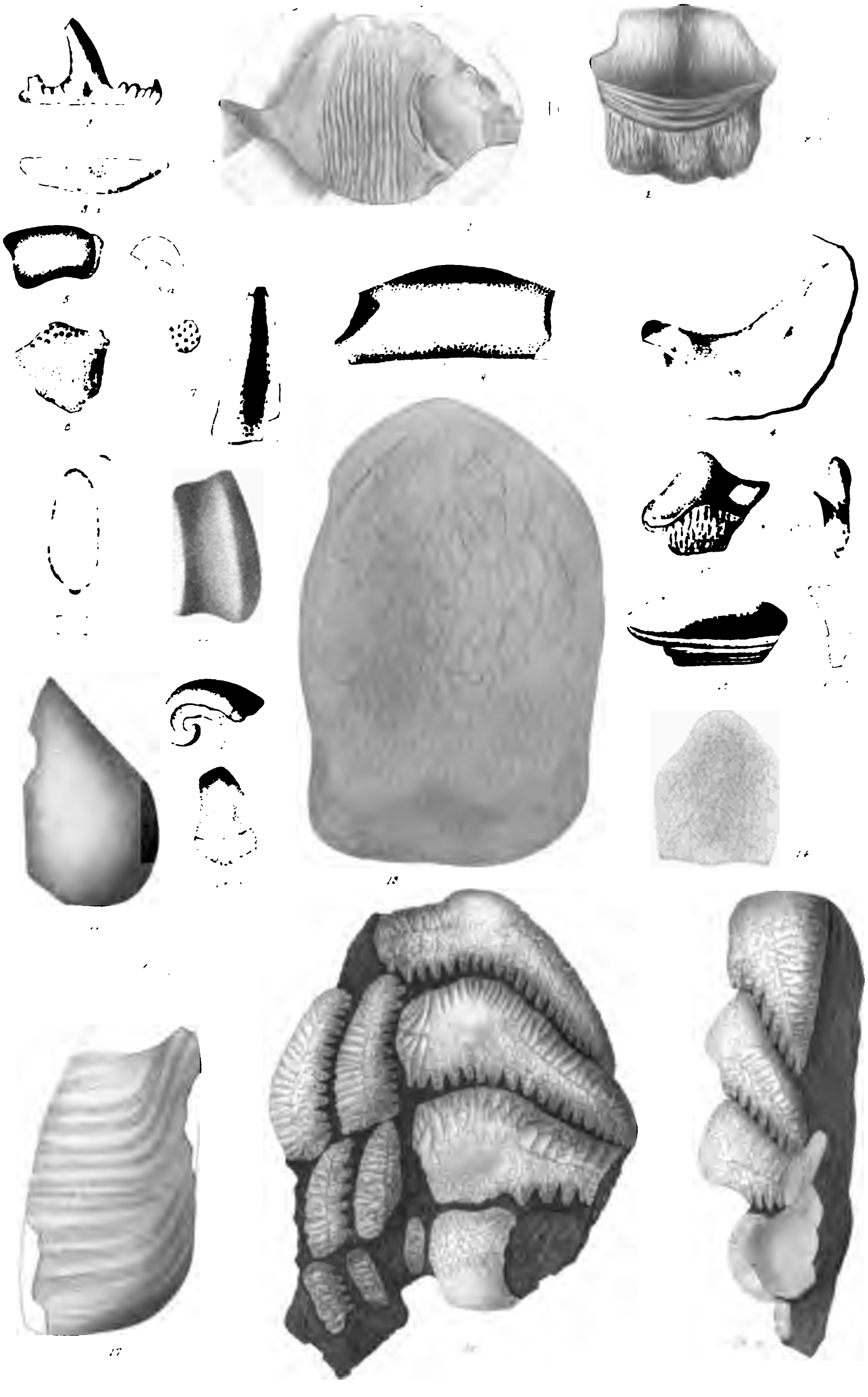
		Page.
Fig. 1.	**Platysomus orbicularis**, N. and W*	
	View of specimen, natural size.	
Fig. 2.	**Petalodus curtus**, N. and W	355
2.	View of inner face of specimen, natural size.	
2 *a*.	Section of the same	
Fig. 3.	**Cladodus deflexus**, N. and W	355
3.	Anterior face, natural size.	
3 *a*.	Outline of base seen from below.	
Fig. 4.	**Palæoniscus gracilis**, N. and W	347
	View of specimen, natural size.	
Fig. 5.	**Deltodus complanatus**, N. and W., vol ii, p. 98.	
5.	View of upper surface of a much worn specimen, natural size.	
8.	Basal portion of a larger individual, also much worn.	
Fig. 6.	**Petrodus ? pustulosus**, N. and W	369
	Upper surface of a small specimen.	
Fig. 7.	**Deltodus angustus**, N. and W	368
	View of specimen, natural size, and enlargement showing the character of the surface punctation.	
Fig. 9.	**Rhizodus reticulatus**, N. and W	349
9.	View of a scale of very small size.	
13.	View of a very large specimen.	
14.	A specimen of medium size; all natural size.	
Fig. 10.	**Cochliodus costatus**, N. and W	364
10.	"Third" tooth, showing crown surface.	
12.	"Second" tooth.	
12 *a*.	The same, seen from above.	
Fig. 11.	**Deltodus spatulatus**, N. and W., vol. ii, p. 100.	
	An imperfect specimen of medium size, seen from above.	
Fig. 15.	**Helodus compressus**, N. and W	360
15.	Posterior face of tooth, natural size.	
15 *a*.	Profile of the same.	
Fig. 16.	**Polyrhizodus truncatus**, N. and W	357
16.	Posterior face, natural size.	
16 *a*.	Section of the same.	
Fig. 17.	**Deltodus fasciatus**, N. and W	366
	View of upper surface of tooth, natural size.	
Fig. 18.	**Orodus corrugatus**, N. and W	358
18.	View of a series of teeth, natural size.	
18 *a*.	Profile of the same.	

---

* The description of this species was unfortunately overlooked.

GEOLOGICAL SURVEY OF ILLINOIS

[illegible] FISHES

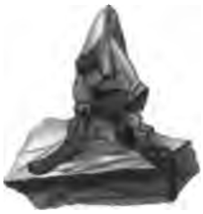


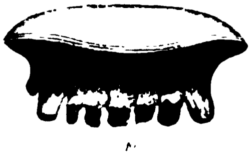
Chas K. Worthen del. A.H Worthen direx. [illegible]

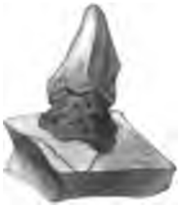
PLATE IV.

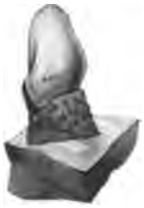
			Page.
Fig.	1.	Rhizodus ooccidentalis, N. and W., vol. ii, p. 19.	
		View of a scale preserved in shale, natural size.	
Fig.	2.	Platysomus circularis, N. and W.	347
		View of a specimen of natural size.	
Fig.	3.	Sandalodus crassus, N. and W	369
	3.	Superior surface of a specimen of ordinary size.	
	3 *a*.	Section of the same.	
Fig.	4.	Lophodus variabilis, N. and W.	361
	4.	Anterior face of tooth, natural size.	
	4 *a*.	" " viewed from above.	
	4 *b*.	" " posterior face.	
	5, 5 *a*.	Anterior and posterior of another specimen, natural size.	
	11.	Anterior face of central ? tooth, natural size.	
	11 *a*.	Posterior face of the same.	
	11 *b*.	" " seen in profile.	
Fig.	6.	Cladodus ischypus, N. and W.	354
	6.	Anterior face of tooth, natural size.	
	6 *a*.	" " " seen in profile.	
Fig.	7.	Cymatodus oblongus, N. and W.	364
	7.	Crown surface, natural size.	
	7 *a*.	Profile of the same.	
Fig.	8.	Deltodus Littoni, N. and W.	367
	8.	Upper surface of a specimen of large size.	
	8 *a*.	The same, seen in profile.	
Fig.	9.	Cladodus elegans, N. and W.	354
		View of the posterior face of tooth, natural size, and section of median cone.	
Fig.	10.	Polyrhizodus Littoni, N. and W.	357
	10.	Anterior face of tooth, natural size.	
	10 *a*.	Section of the same	

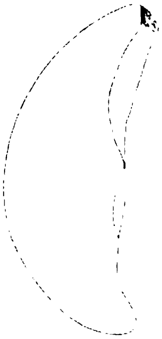
GEOLOGICAL SURVEY OF ILLINOIS

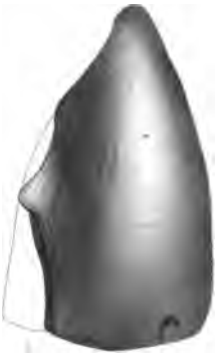

11 a

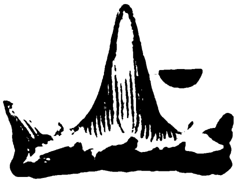


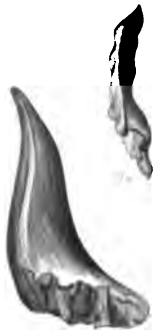

11

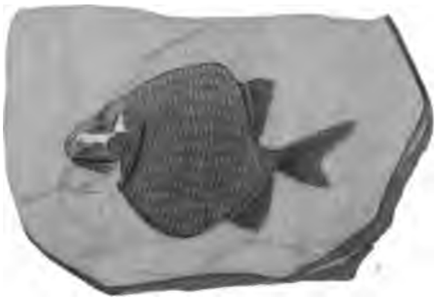

11 b

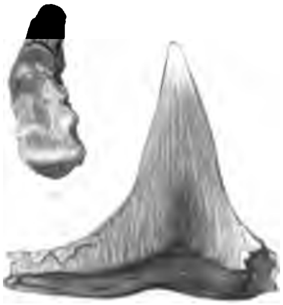


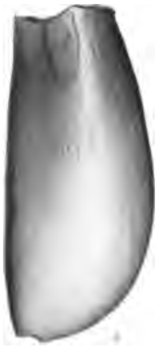


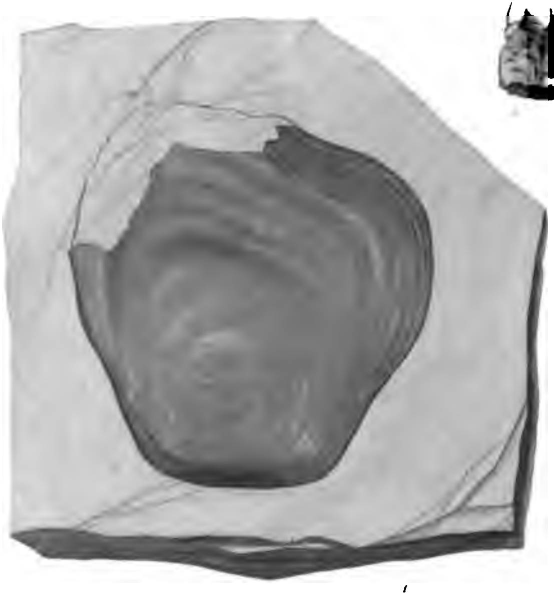












A. H. Worthen direxit

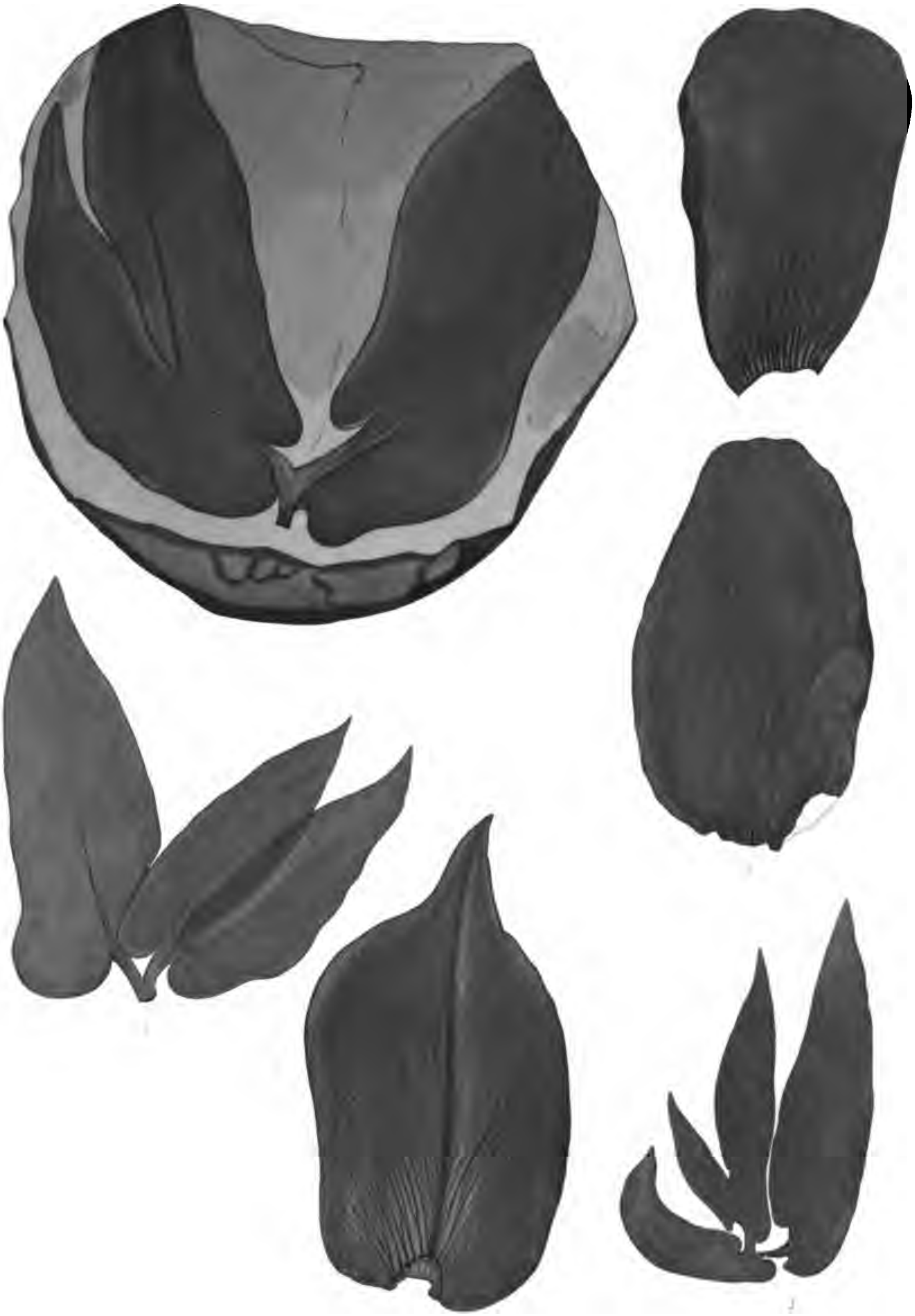
Western Engraving Co. Chicago.

PLATE V.

		Page.
Fig. 1 to 4.	Neuropteris fasciculata, Sp. nov.	381
Fig. 5 and 6.	Neuropteris Collinsii, Sp. nov.	382

GEOLOGICAL SURVEY OF ILLINOIS

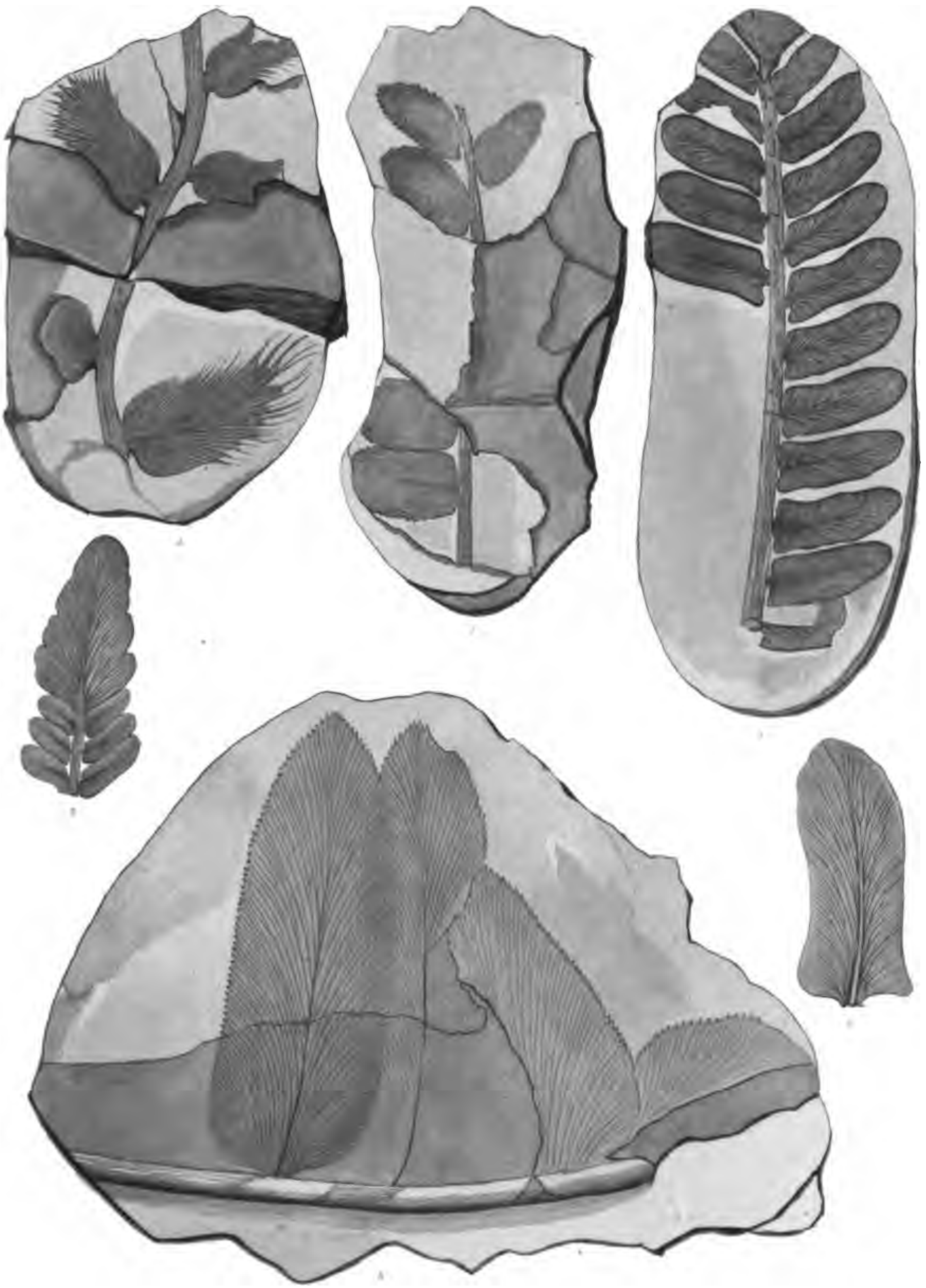
CARBONIFEROUS Coal Measures FOSSIL FLORA



A. H. Worthen, Del.

PLATE VI.

		PAGE.
Fig. 1.	NEUROPTERIS VERMICULARIS, Lesqx.	385
Fig. 1.	Enlarged pinnule of the same	
Fig. 3.	Terminal leaflet of a pinna of the same.	
Fig. 4.	NEUROPTERIS FIMBRIATA, Lesqx.	384
Fig. 5 and 6.	NEUROPTERIS VERBENÆFOLIA, Lesqx.	385



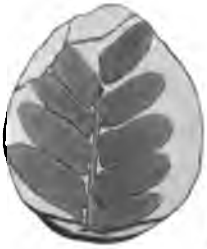
L. Lesquereux del. A. H. Worthen dirext [illegible]

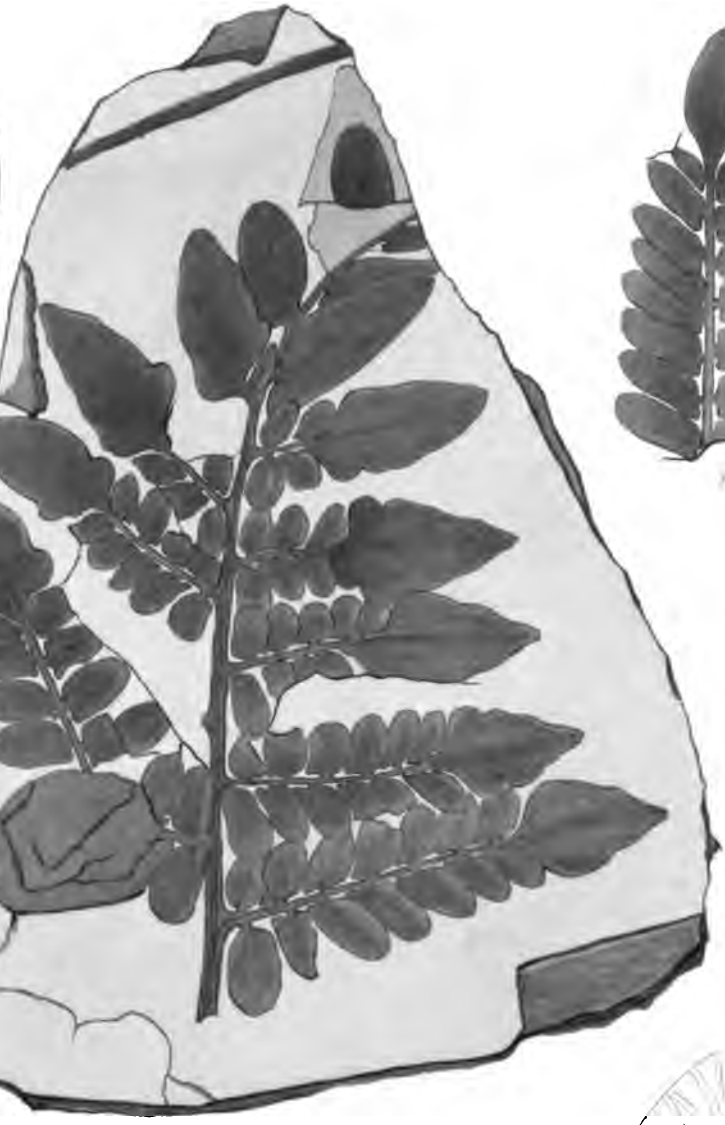
PLATE VII.

		PAGE.
Fig. 1.	NEUROPTERIS CAPITATA, Sp. nov.	383
Fig. 2 to 5.	DICTYOPTERIS RUBELLA, Sp. nov.	388
Fig. 6.	Part of a much enlarged pinnule of the same.	

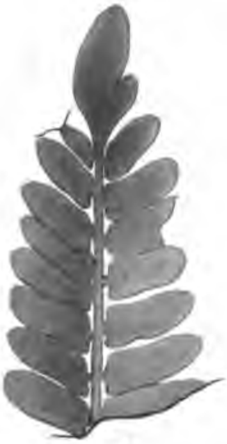
GEOLOGICAL SURVEY OF ILLINOIS

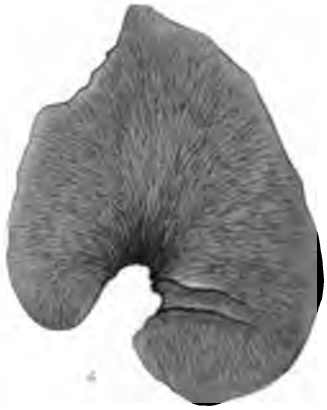
CARBONIFEROUS Coal Measures FOSSIL FLORA

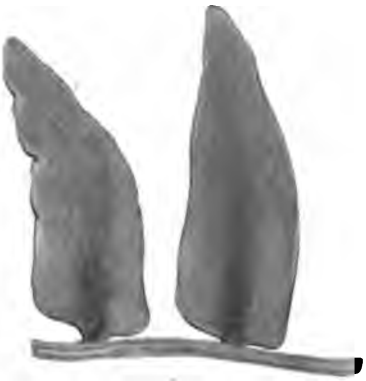




1





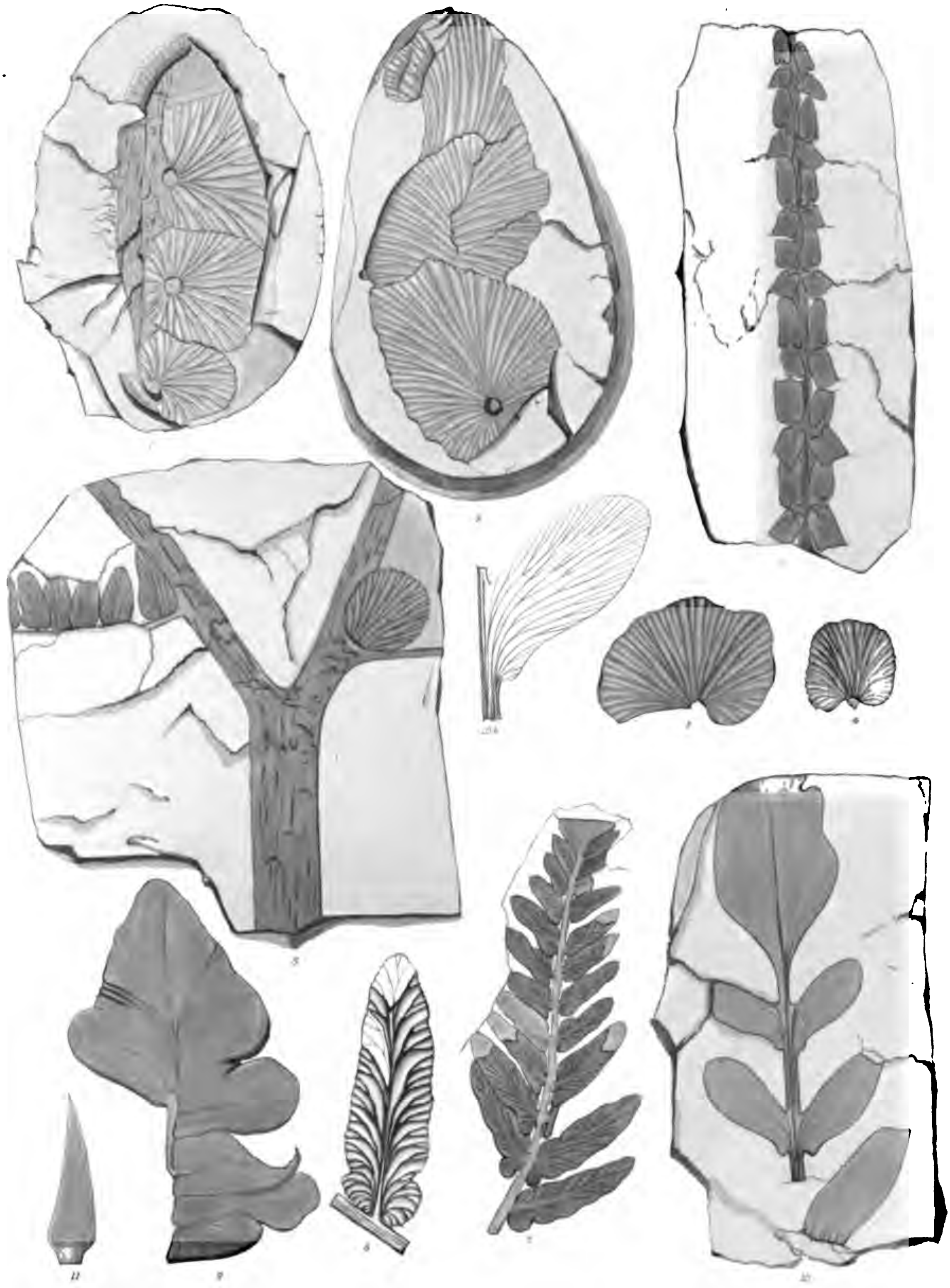


5

6

PLATE VIII.

		Page.
Fig. 1 to 4.	Neuropteris (Cyclopteris) rarinervis ? Bunb.	386
Fig. 5 and 6.	Neuropteris rarinervis, Bunb.	
Fig. 7.	Neuropteris coriacea, Sp. nov.	387
Fig. 8.	Pinnule of the same enlarged twice.	
Fig. 9.	Neuropteris capitata, Sp. nov.	383
Fig. 10.	Odontopteris subcuneata, Bunb.	390
Fig. 11.	Odontopteris Bradleyi, Sp. nov.	390



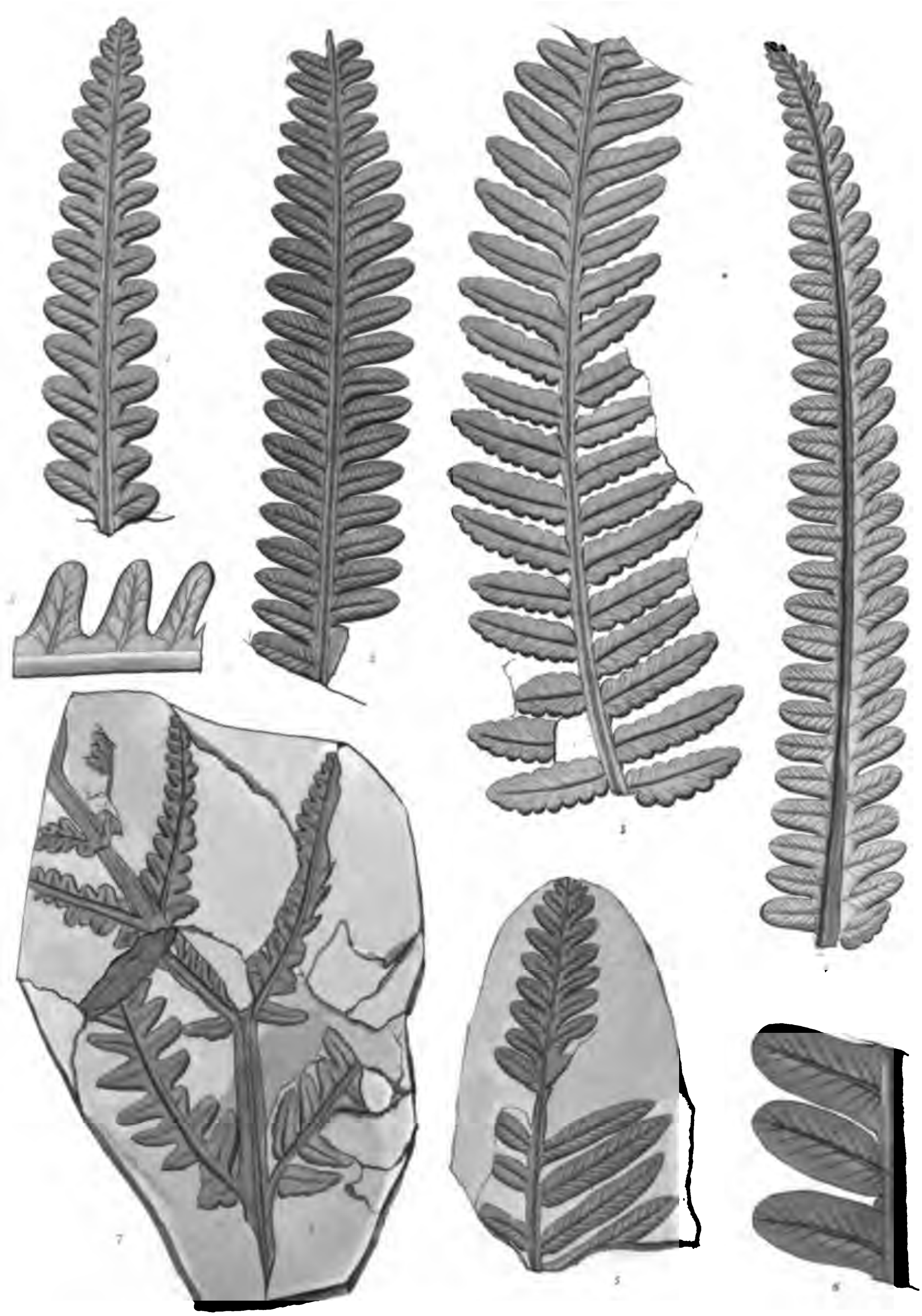
[illegible] A. H. Worthen Direxit Western Engraving Co. Chicago

PLATE IX

		PAGE.
Fig. 1 to 7.	ALETHOPTERIS MAZONIANA, Spec. nov	391
Fig. 6 and 8.	Enlarged pinnules of the same.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS FOSSIL FLORA



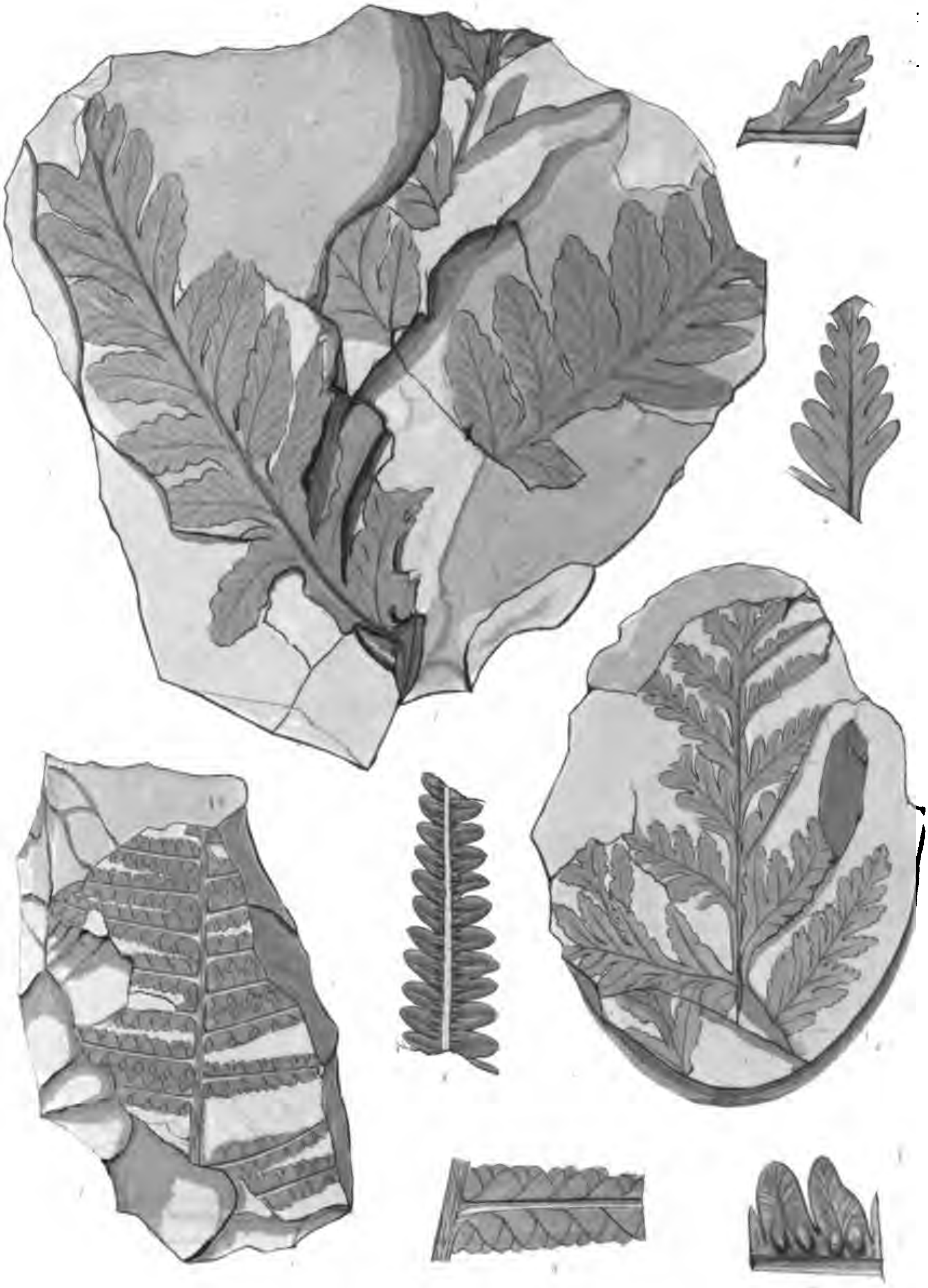
Leo Lesquereux del. [illegible] [illegible] Chicago

PLATE X.

		PAGE.
Fig. 1 and 2.	ALETHOPTERIS HYMENOPHYLLOIDES, Spec. nov	393
Fig. 3 and 4.	Enlarged pinnules of fig. 2.	
Fig. 5.	ALETHOPTERIS INFLATA, Spec. nov	393
Fig. 6.	Enlarged part of the same.	
Fig. 7.	ALETHOPTERIS HALLII, Spec. nov	394
Fig. 8.	Enlarged pinna of the same.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS FOSSIL FLORA



[illegible]

PLATE XI.

		Page.
Fig. 1.	ALETHOPTERIS SPINULOSA, Spec. nov	396
Fig. 2.	Enlarged pinnules of the same, showing nervation.	
Fig. 3.	ALETHOPTERIS FALCATA, Spec. nov	396
Fig. 4.	Pinnule of the same, showing nervation.	
Fig. 5.	ALETHOPTERIS SOLIDA, Spec. nov	397
Fig. 6.	Pinnule of the same, with group of sporanges.	
Fig. 7.	Group of sporanges, much enlarged.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS FOSSIL FLORA.

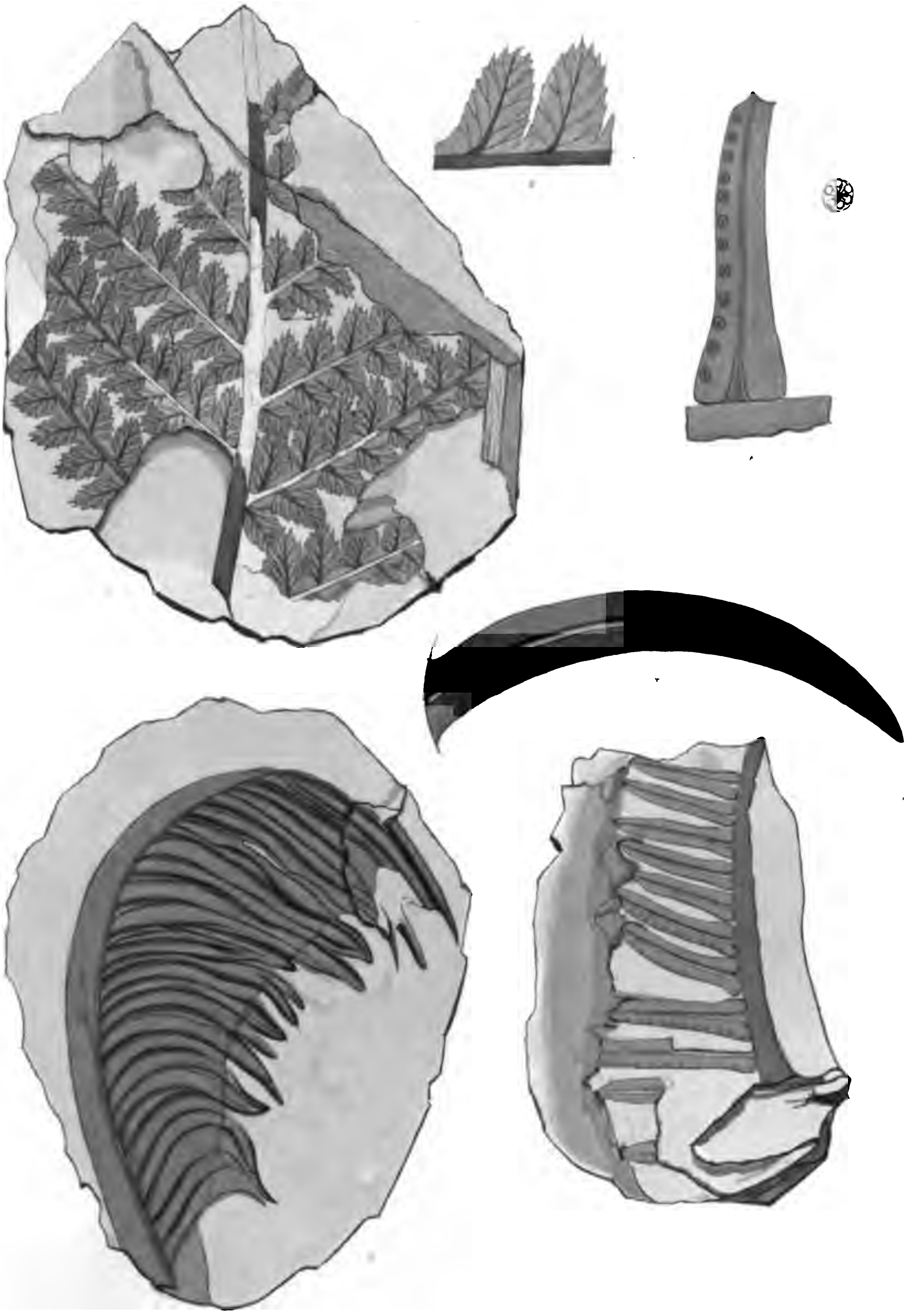
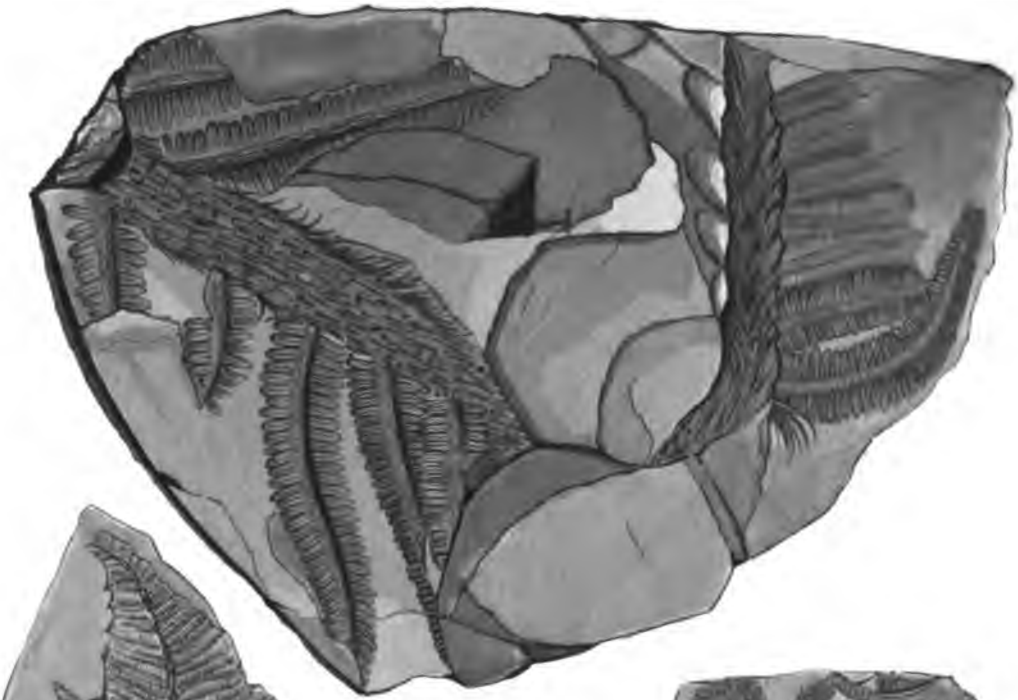
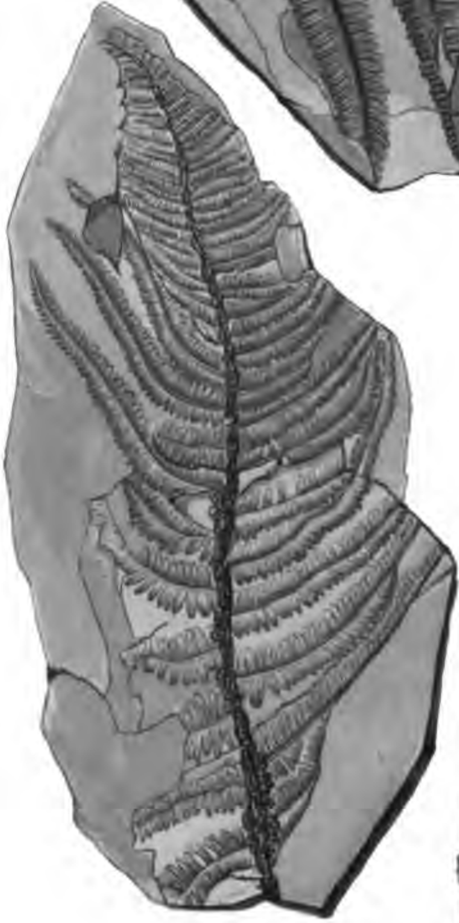


PLATE XII.

		PAGE.
Fig. 1 to 3.	PECOPTERIS SQUAMOSA, Spec. nov	400
Fig. 4	Part of an enlarged pinna of the same.	

GEOLOGICAL SURVEY OF ILLINOIS





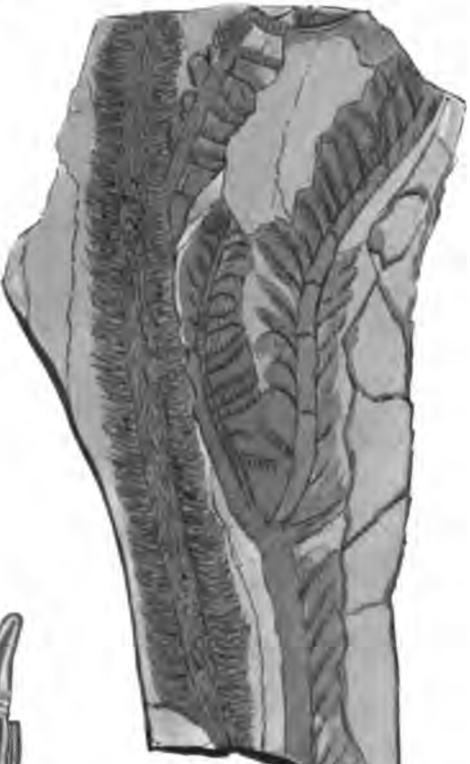
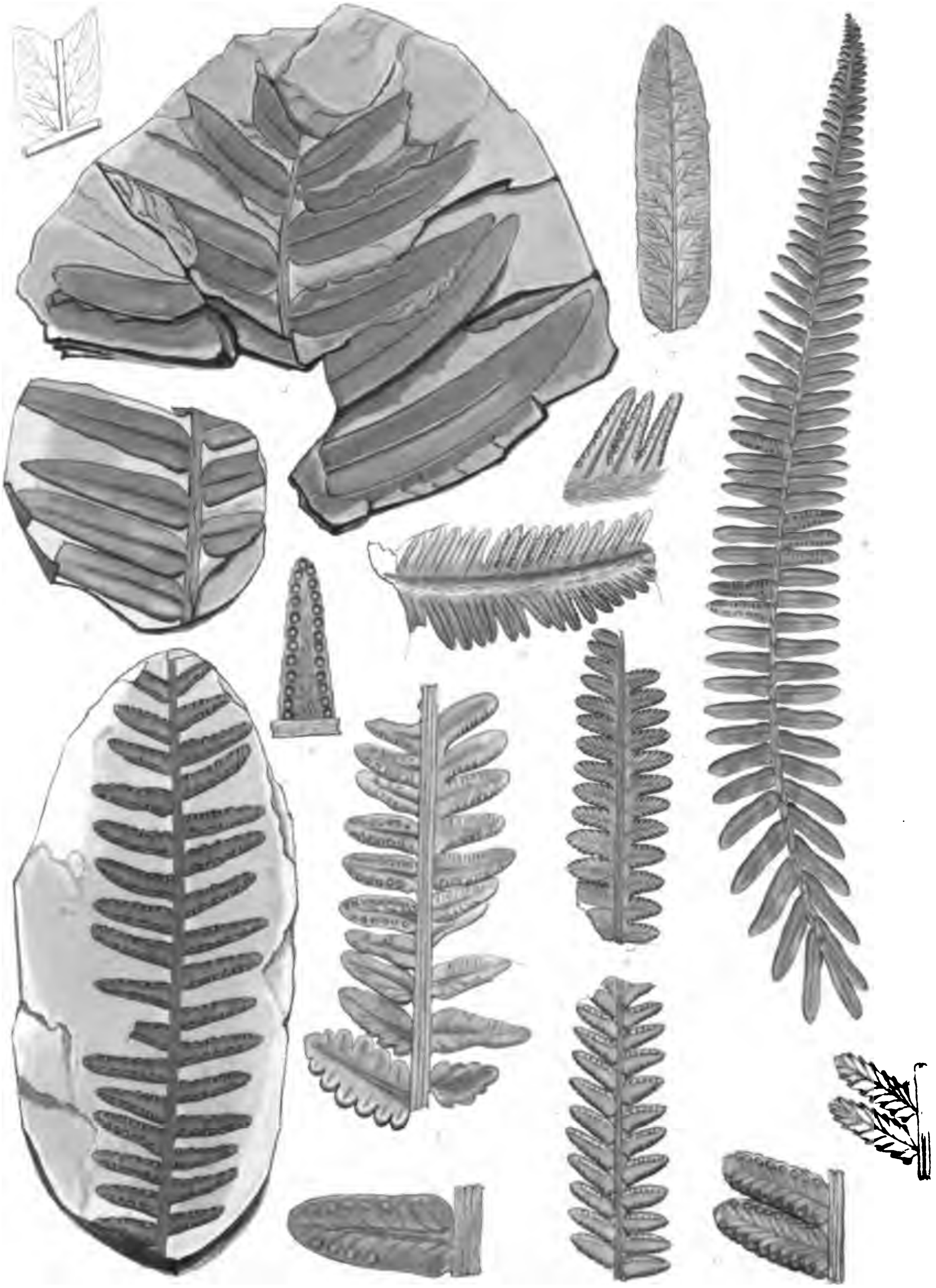


PLATE XIII.

		Page.
Fig. 1 and 3.	Alethopteris lanceolata, Spec. nov	398
Fig. 2.	Enlarged part of pinnule of the same.	
Fig. 4.	Alethopteris emarginata, Gopp	398
Fig. 5.	Alethopteris Mazoniana, Lesqx. (Fruiting,)	391
Fig. 6.	Enlarged pinnule of the same.	
Fig. 7 and 9.	Pecopteris Strongii, Spec. nov	399
Fig. 8.	An enlarged pinnule of fig. 7.	
Fig. 10.	Pecopteris squamosa, Lesqx., (Fruiting,)	400
Fig. 11.	Enlarged part of the same.	
Fig. 12.	Pecopteris arguta, Brgt., (Fruiting,)	402
Fig. 13.	Enlarged part of the same.	
Fig. 14.	Alethopteris crenulata, Brgt., (Fruiting,)	392
Fig. 15.	Enlarged pinnules of the same.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS | FOSSIL PLANTS



A. H. Worthen, Dir.

PLATE XIV.

		Page.
Fig. 1.	STAPHYLOPTERIS WORTHENII, Spec. nov	405
Fig. 2 and 2 *b*.	Groups of its sporanges, enlarged.	
Fig. 3.	STAPHYLOPTERIS SAGITTATUS, Spec. nov	407
Fig. 4 and 5.	Sporanges and their cells, enlarged.	
Fig. 6.	STAPHYLOPTERIS ASTEROIDES, Spec. nov	406
Fig. 7.	Opened *sori* of the same, enlarged.	
Fig. 8.	Round unopened *sori* of the same? natural size.	
Fig. 9 and 10.	Same, enlarged.	

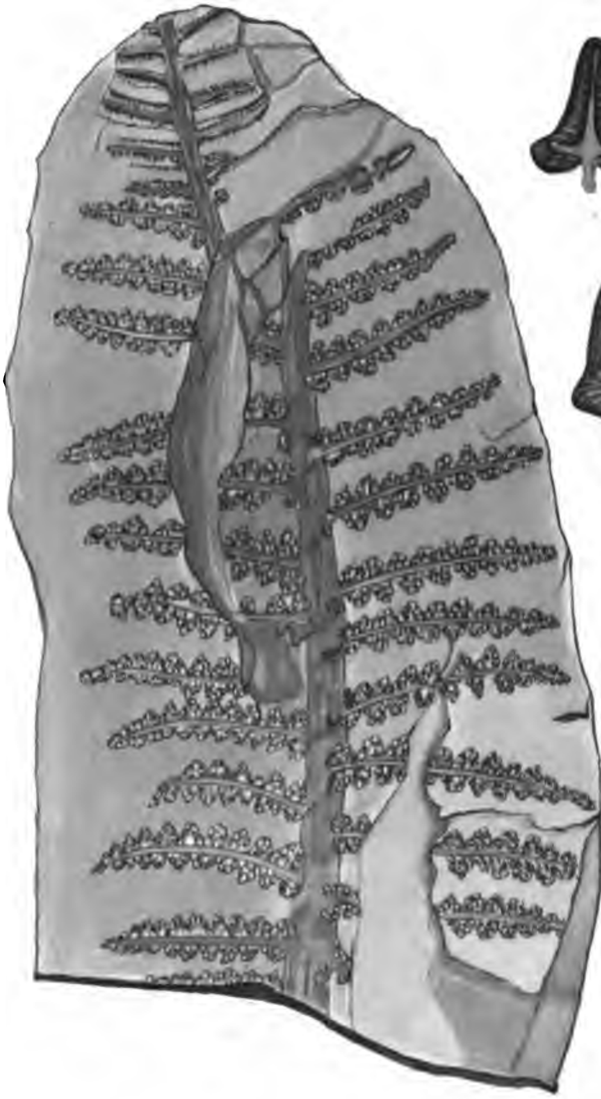


PLATE XV.

		PAGE.
Fig. 1.	SPHENOPTERIS SCABERRIMA, Spec. nova	408
Fig. 2.	Pinna of the same, enlarged.	
Fig. 3.	SPHENOPTERIS GRACILIS, Brgt	408
Fig. 4, 5, 6.	Enlarged pinnules of the same.	
Fig. 7.	SPHENOPTERIS MIXTA, Schp	409
Fig. 6.	Enlarged pinna of the same.	

Pl. [illegible]

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS

FOSSIL PLANTS

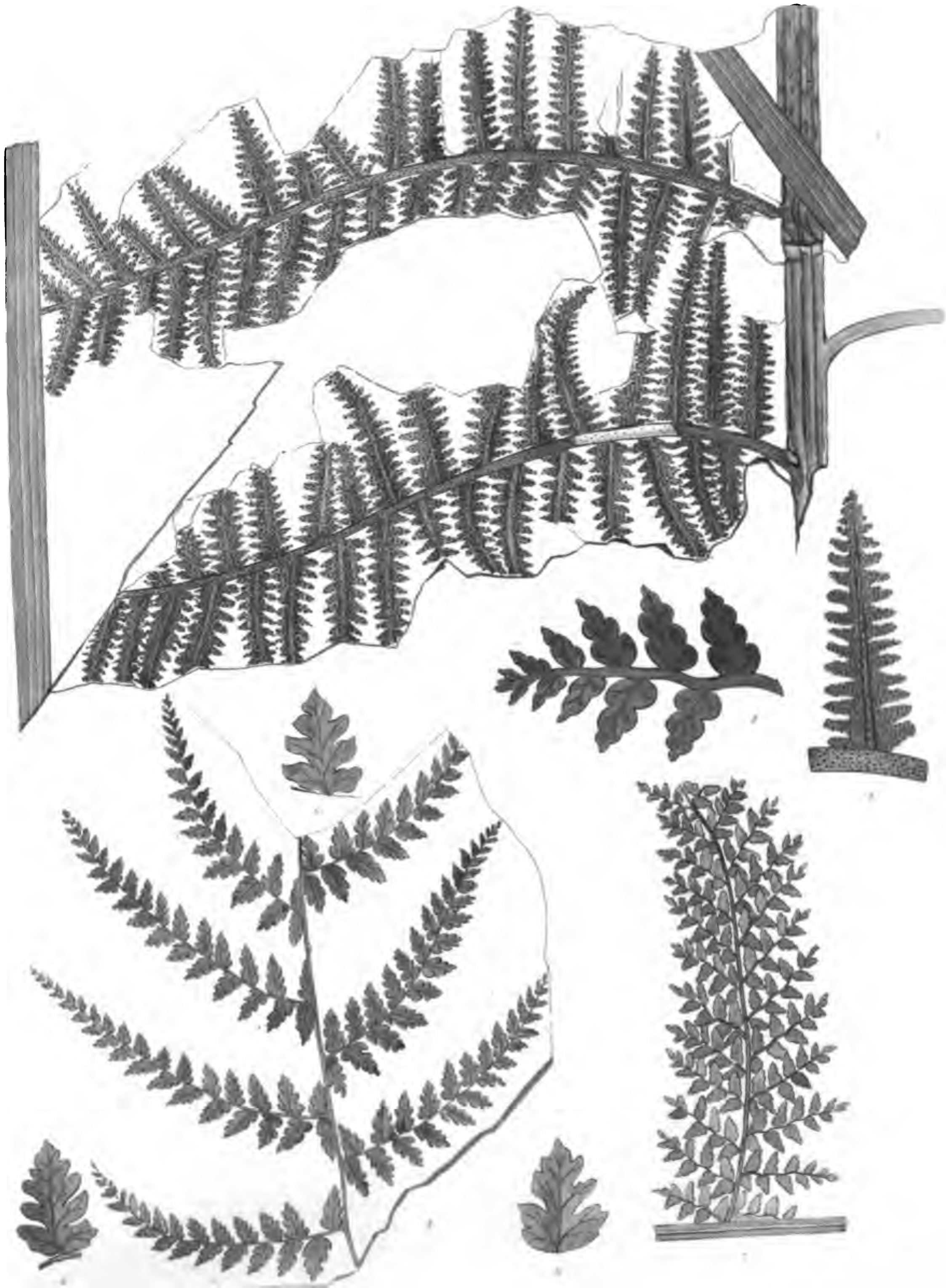
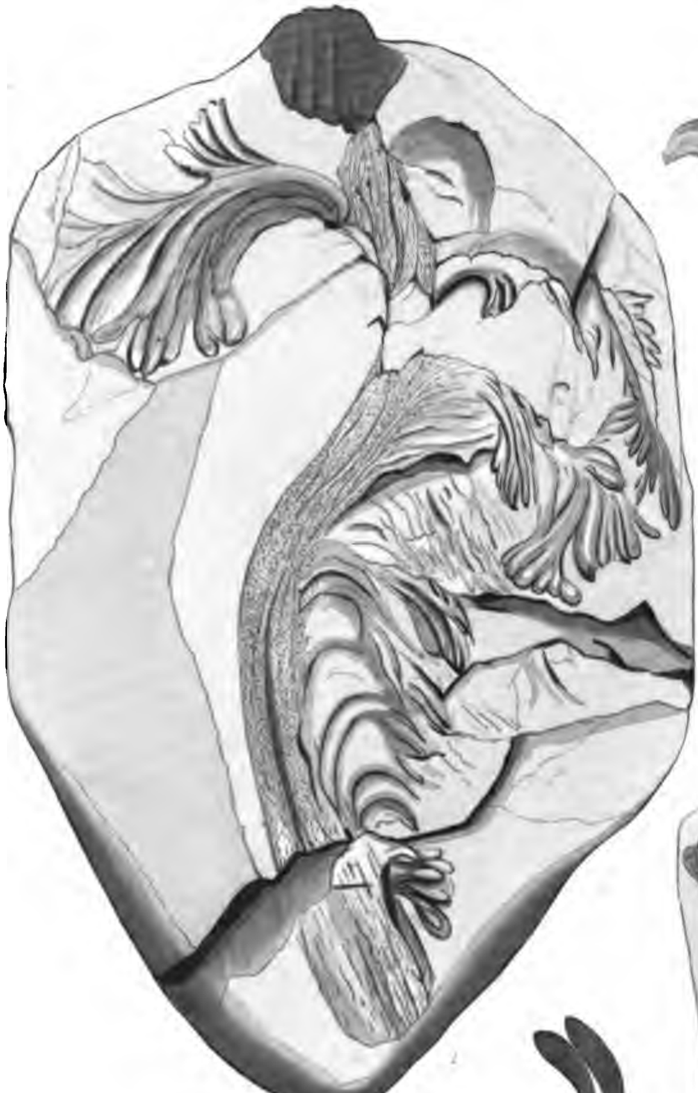


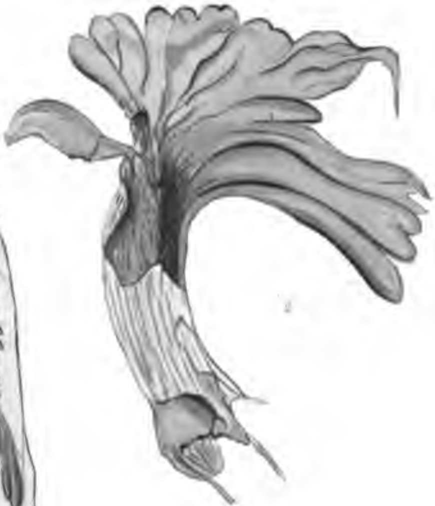
PLATE XVI.

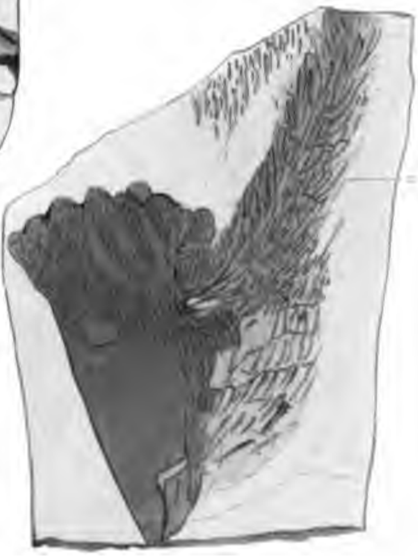
		PAGE.
Fig. 1 and 2.	Hymenophyllites Clarkii, Lesqx	416
Fig. 3 and 5.	Hymenophyllites thallyformis, Spec. nov	417
Fig. 4.	Scales of the same, enlarged.	
Fig. 6.	Hymenophyllites inflatus, Spec. nov	414
Fig. 6 *a*.	Inflated lobe of the same.	
Fig. 7.	Hymenophyllites adnascens? Ll. and Hutt.	414
Fig. 8.	Hymenophyllites adnascens, Ll. and Hutt.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS [illegible] FOSSIL FLORA







3

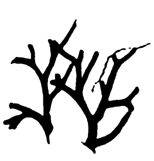


PLATE XVII.

PAGE.

Fig. 1. **HYMENOPHYLLITES ARBORESCENS**, Spec. nov. 415

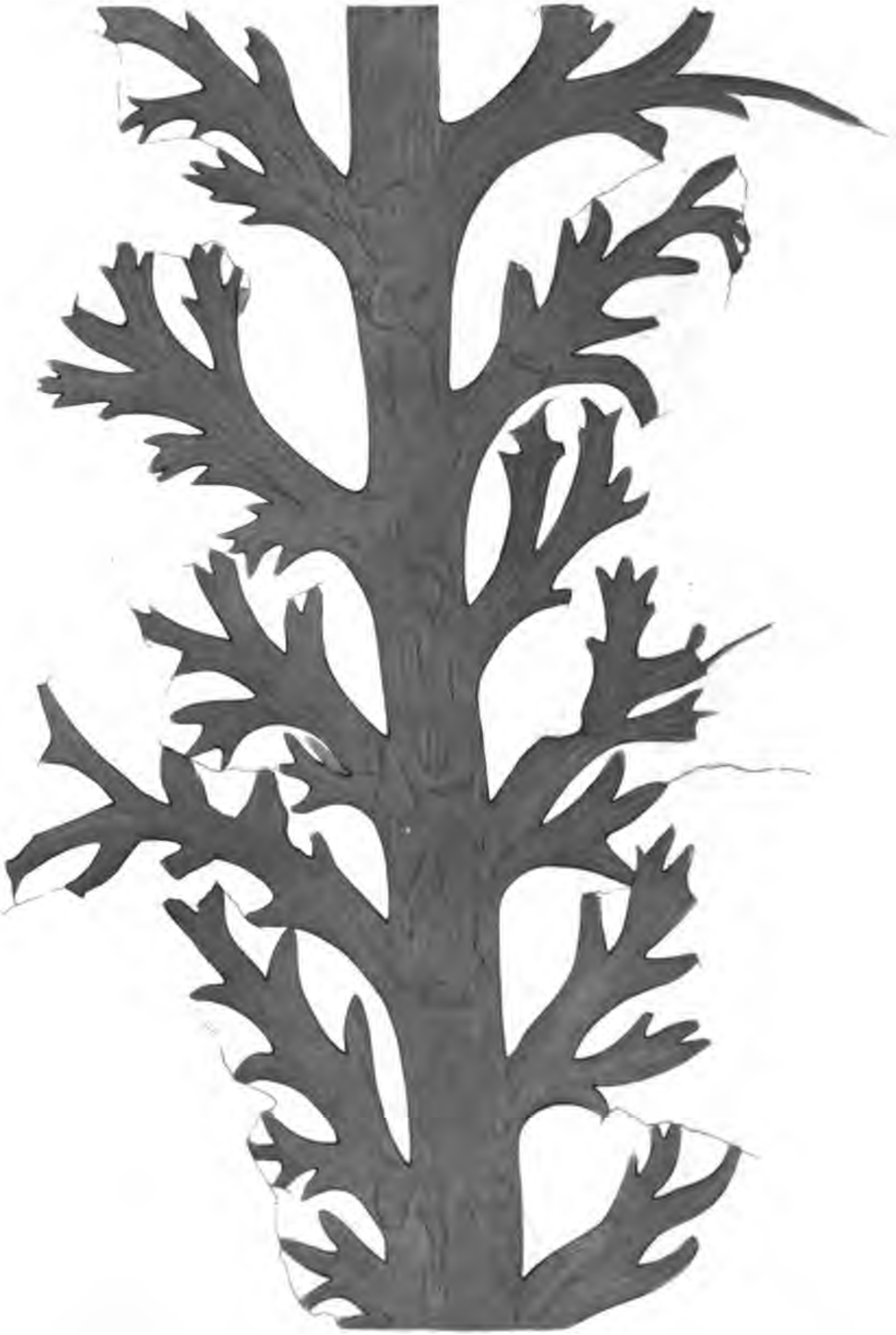


PLATE XVIII.

		Page.
Fig. 1.	Hymenophyllites Strongii, Spec. nov	417
Fig. 2, 4, 5, 6.	Hymenophyllites mollis, Spec. nov	418
Fig. 3.	Fragments of fig. 2, slightly enlarged.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS FOSSIL FLORA

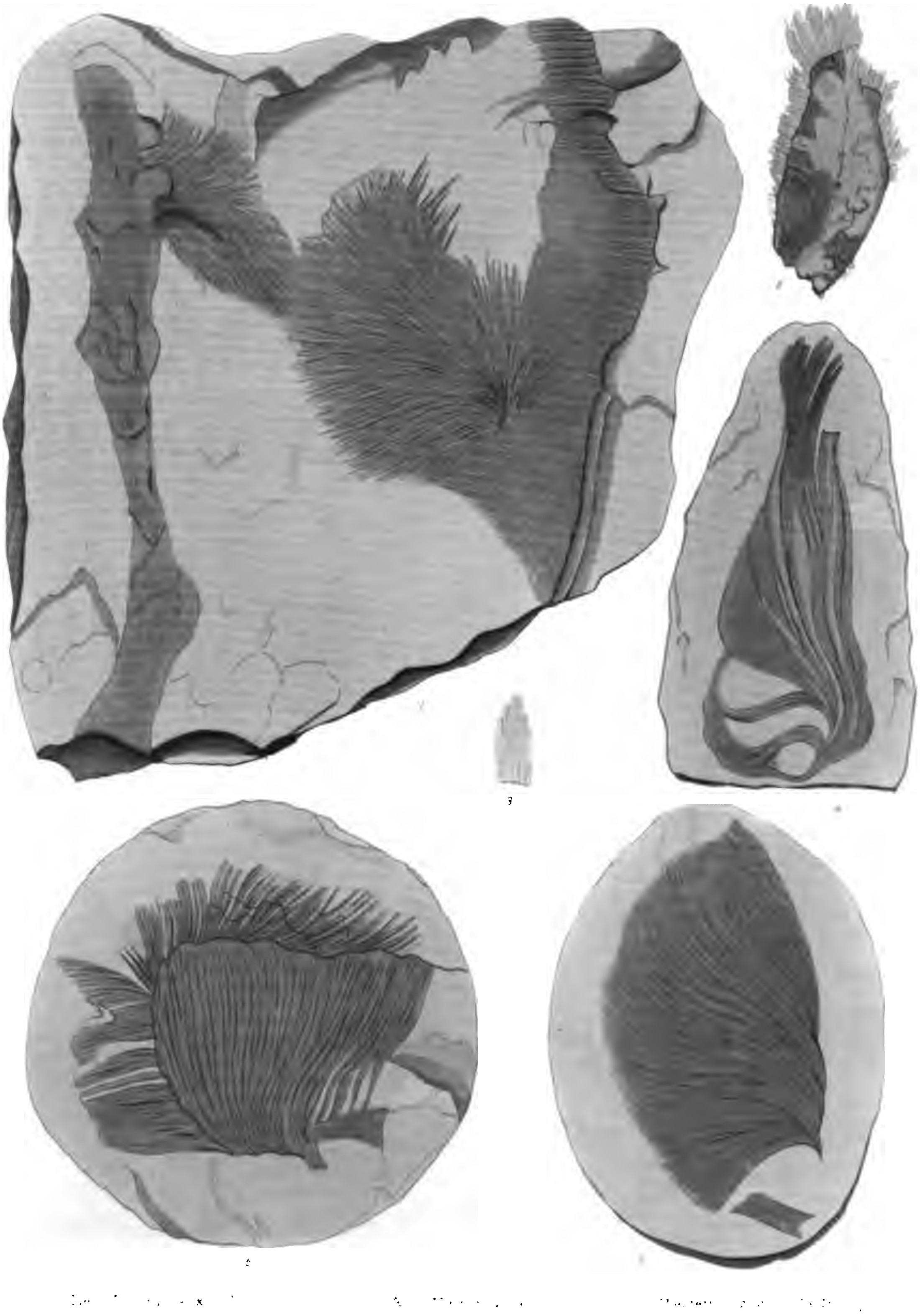


PLATE XIX.

		PAGE.
Fig. 1, 2, 3.	SPHENOPHYLLUM CORNUTUM, Spec. nov	421
Fig. 4.	Large leaflets of the same, natural size.	
Fig. 5.	Enlarged part of the same.	
Fig. 2 *a*.	HYMENOPHYLLITES SPLENDENS, Spec. nov	418
Fig. 2 *b*.	Part of a pinna of the same.	
Fig. 6.	PACHYPTERIS GRACILLIMA, Spec. nov	419
Fig. 7 and 8.	The same, enlarged.	

GEOLOGICAL SURVEY OF ILLINOIS

PALEONTOLOGY [illegible] FOSSIL FLORA

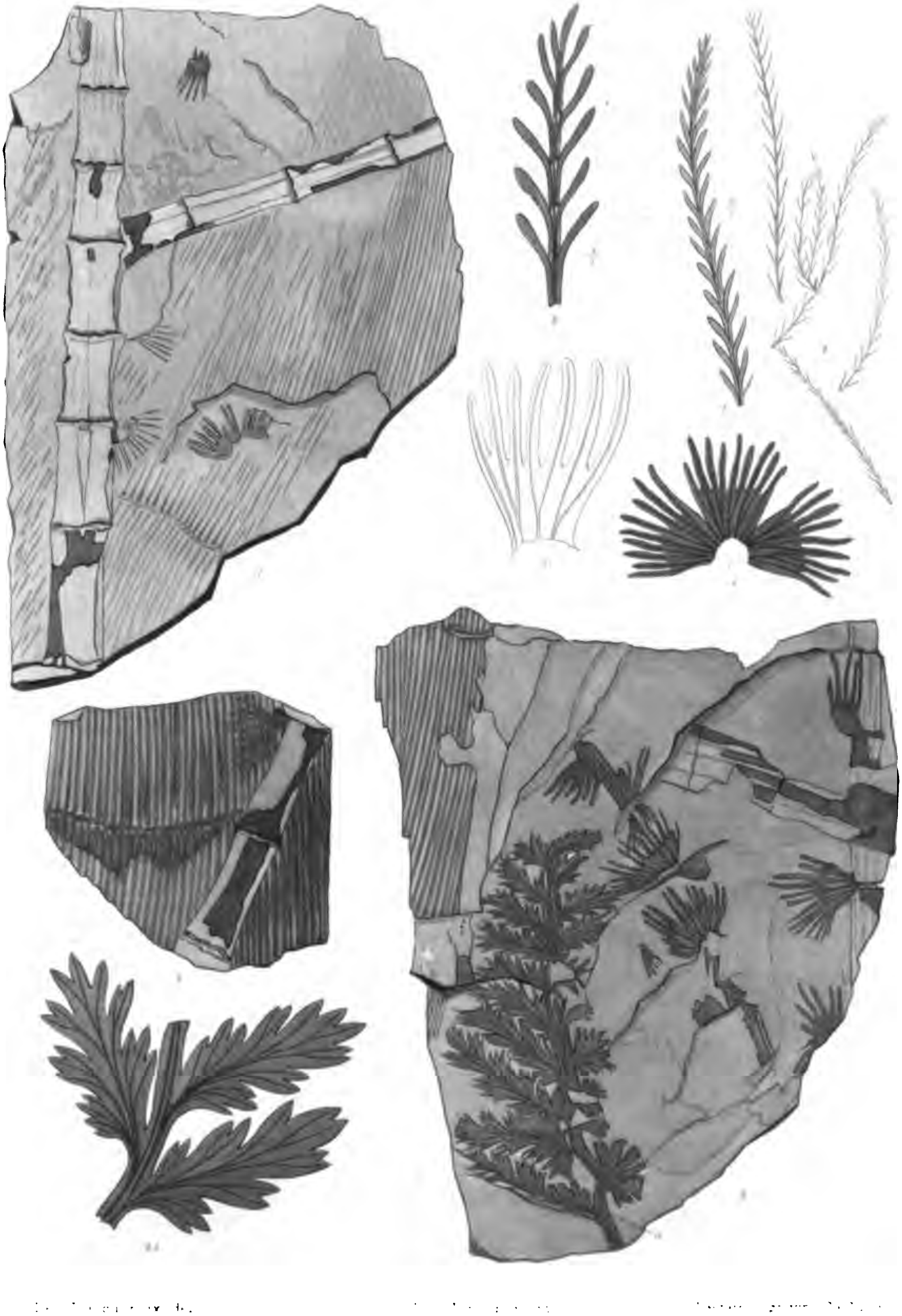


PLATE XX.

		PAGE.
Fig. 1 and 2.	ANNULARIA INFLATA, Spec. nov	423
Fig. 3 and 3 *b*.	**Leaf of the same, and its cross section.**	
Fig. 4 and 4 *b*.	**Leaf of** ANNULARIA LONGIFOLIA, **Brgt., and its cross section**	422
Fig. 5.	EQUISETITES OCCIDENTALIS, Spec. nov	425

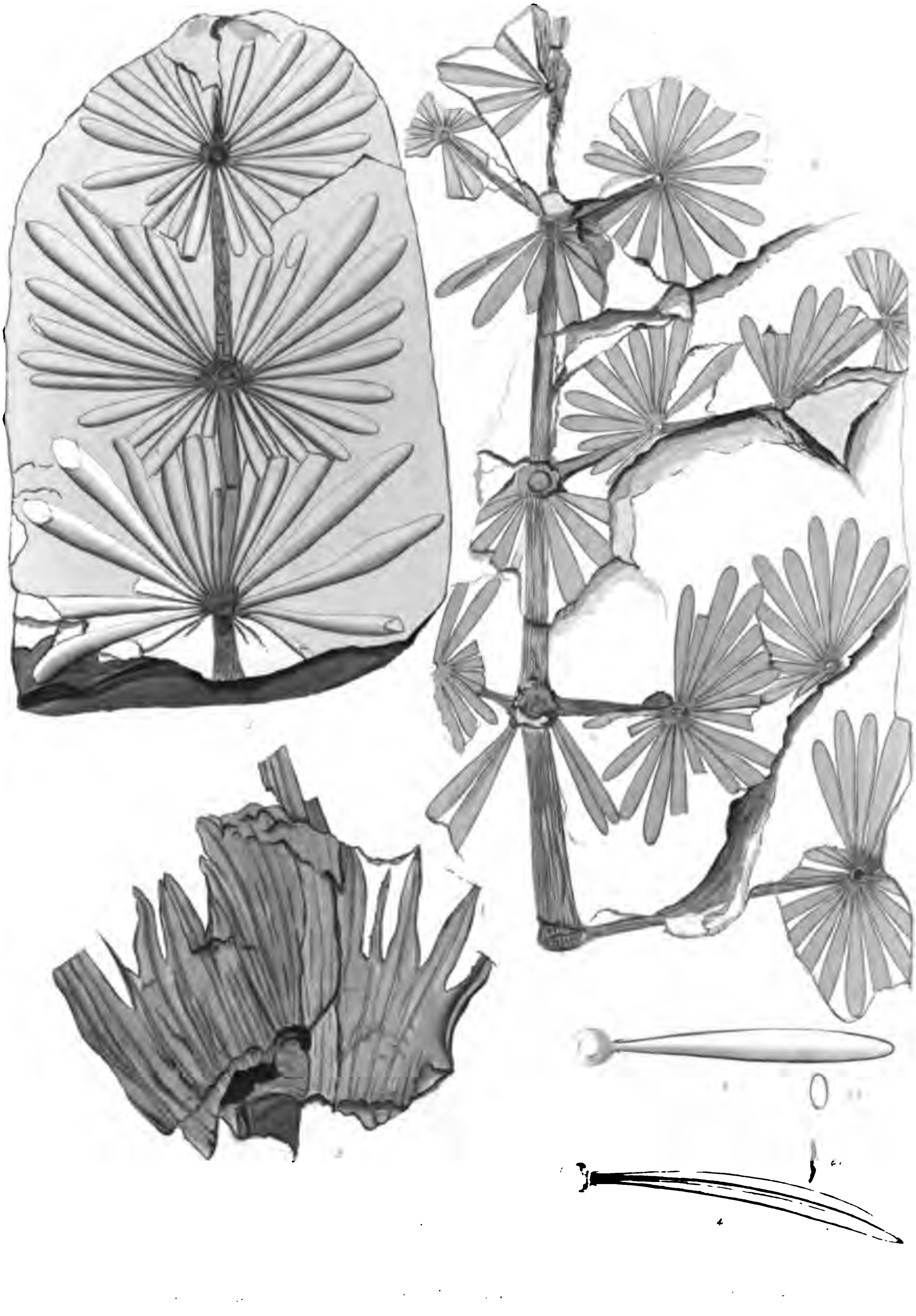

2
4

PLATE XXI.

		PAGE.
Fig. 1 and 2.	ANNULARIA LONGIFOLIA? Brgt.	422
Fig. 3.	Enlarged leaf of the same.	
Fig. 4.	ASTEROPHYLLITES RIGIDUS, Brgt.	424
Fig. 4*a*.	Fragment of an enlarged leaf of the same.	
Fig. 5.	LYCOPODITES ANNULARIÆFOLIUS, Spec. nov.	426
Fig. 6.	SCHUTZIA BRACTEATA, Spec. nov.	427
Fig. 7.	Enlarged cone *a*.	
Fig. 8.	Enlarged scales of the cone.	
Fig. 9.	Part of membrane containing pulverulent matter, much enlarged.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS [illegible] FOSSIL FLORA

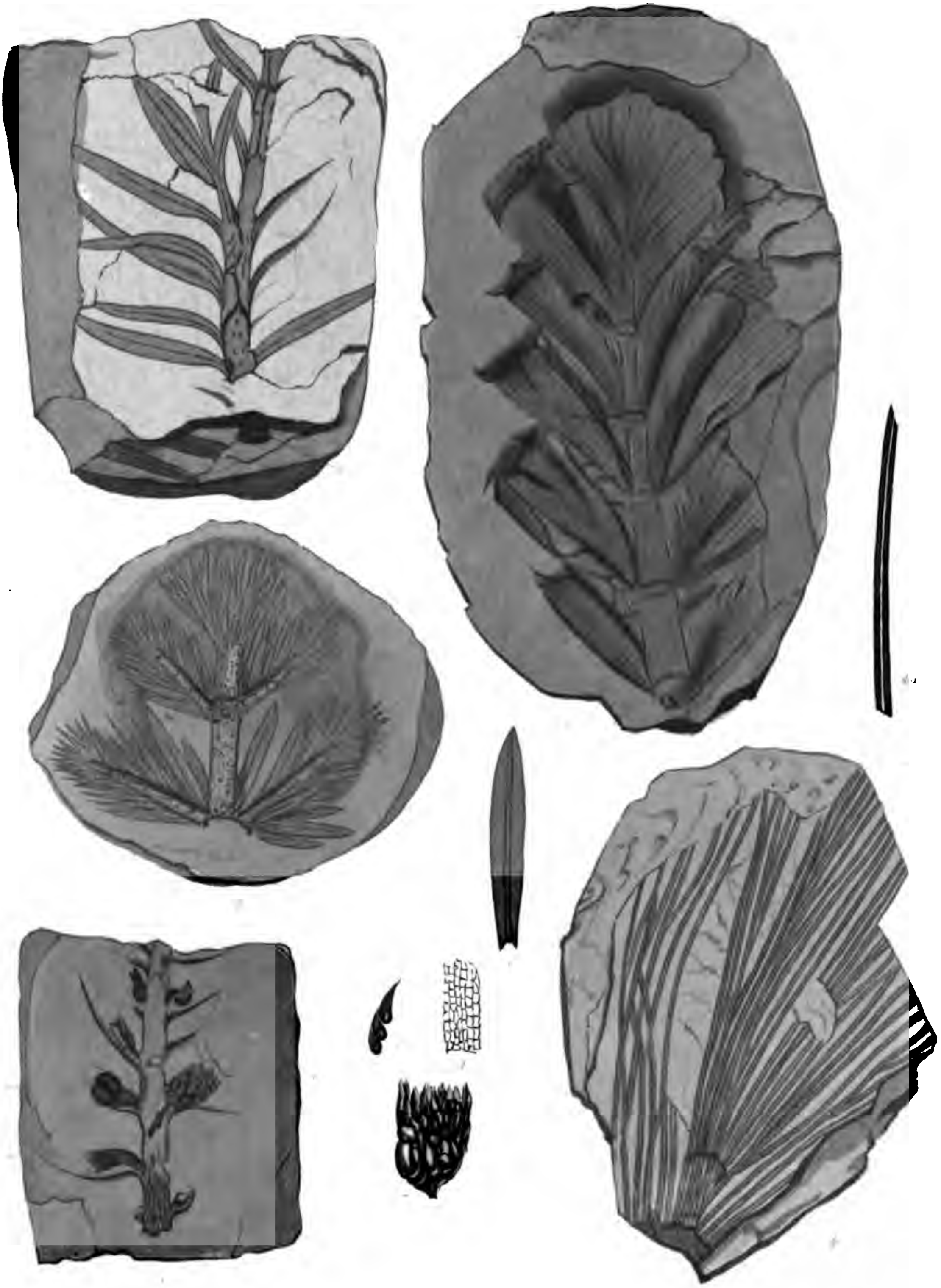


PLATE XXII.

		PAGE.
Fig. 1.	LEPIDODENDRON MORRISIANUM, Spec. nov	430
Fig. 2.	Enlarged leaf of the same.	
Fig. 3.	ULODENDRON ELLIPTICUM, Sternb	436
Fig. 4.	ULODENDRON MAJUS, Ll. and Hutt	435
Fig. 4*a*.	Cicatrices in their primitive state.	
Fig. 4*b*.	The same, obliterated by age.	
Fig. 4*c*.	The same, decorticated.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS　　　　　　　　FOSSIL FLORA

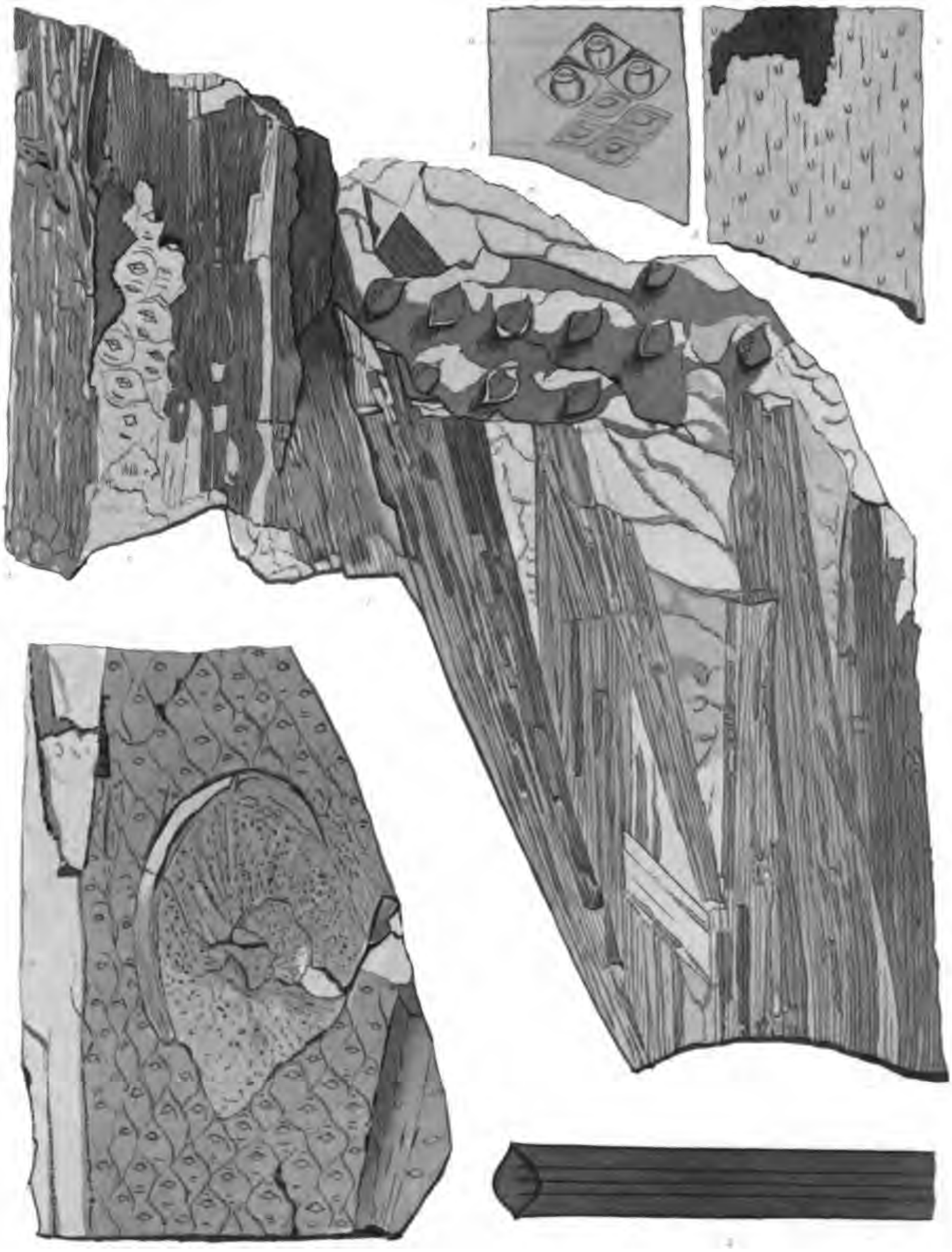
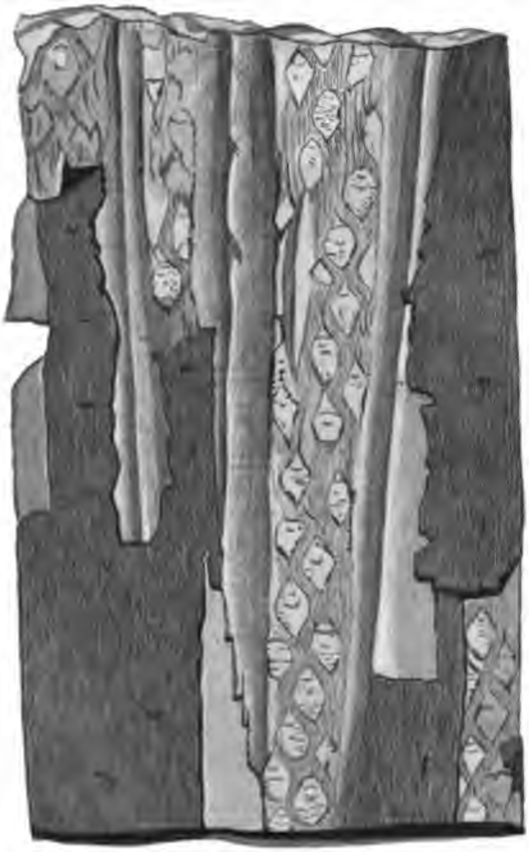


PLATE XXIII.

		Page.
Fig. 1 and 2.	Ulodendron ellipticum, Sternb	436
Fig. 3.	Cicatrices of the same, enlarged twice.	
Fig. 4.	Ulodendron elongatum, Spec. nov	487
Fig. 5.	Lepidodendron forulatum, Spec. nov	481
Fig. 6.	Enlarged cicatrice of the same.	
Fig. 7.	Lepidodendron forulatum, decorticated.	
Fig. 8.	Enlarged cicatrice of the same.	



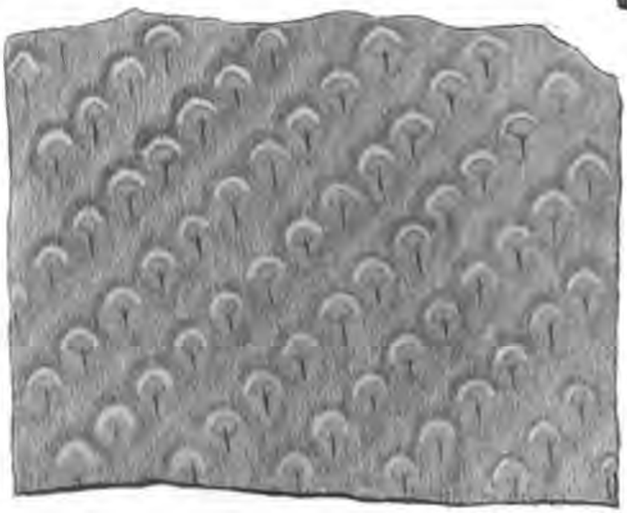


PLATE XXIV.

Page.

Fig. 1 and 2. Lepidodendron Tijoui, Spec. nov 431

Fig. 1*b* and 2. Enlarged cicatrices of the same.

Fig. 3. The same species, decorticated.

Fig. 3*b*. Enlarged cicatrice of the same.

Fig. 4. Sigillaria corrugata, Spec. nov.............................. 445

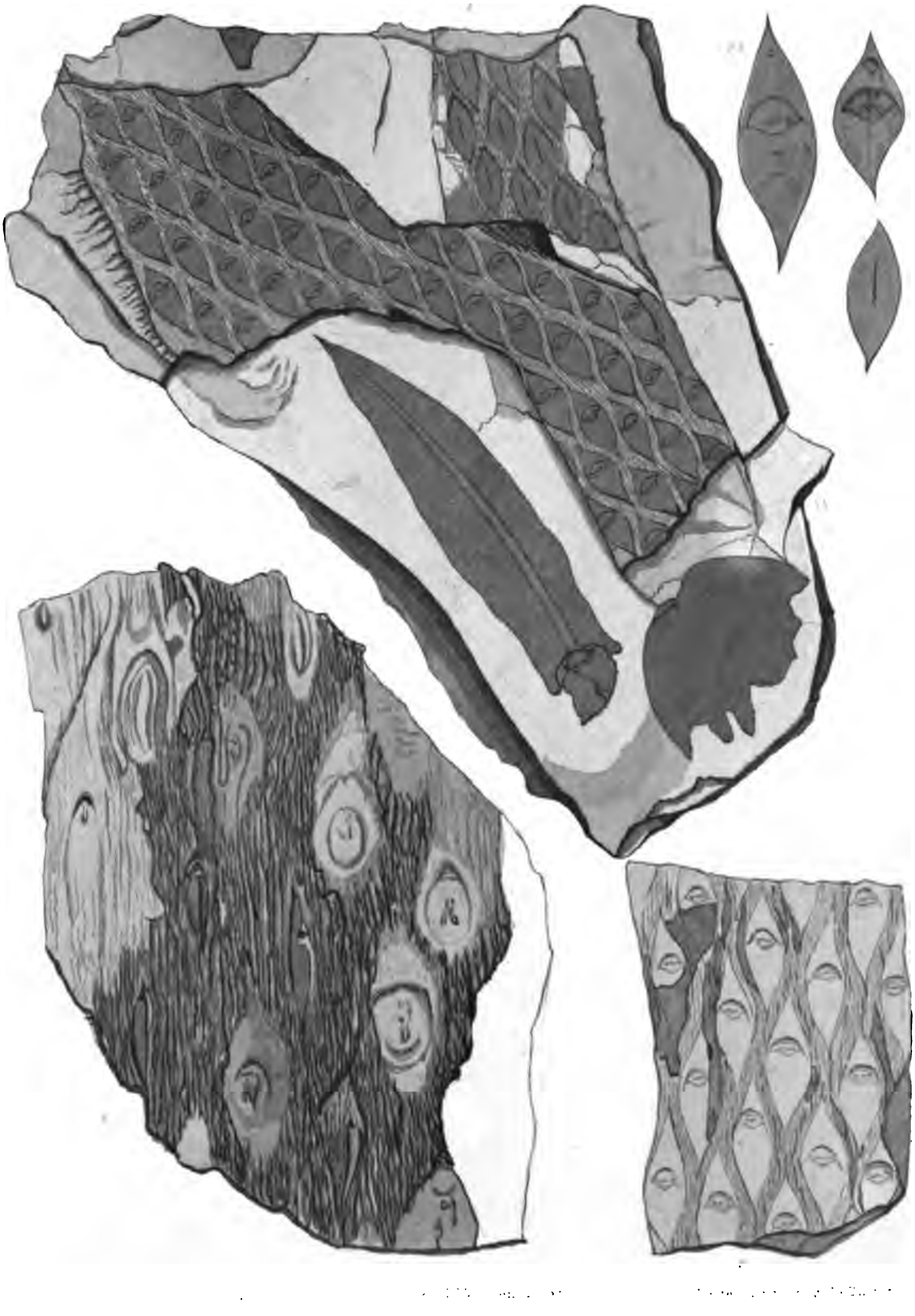


PLATE XXV.

PAGE.

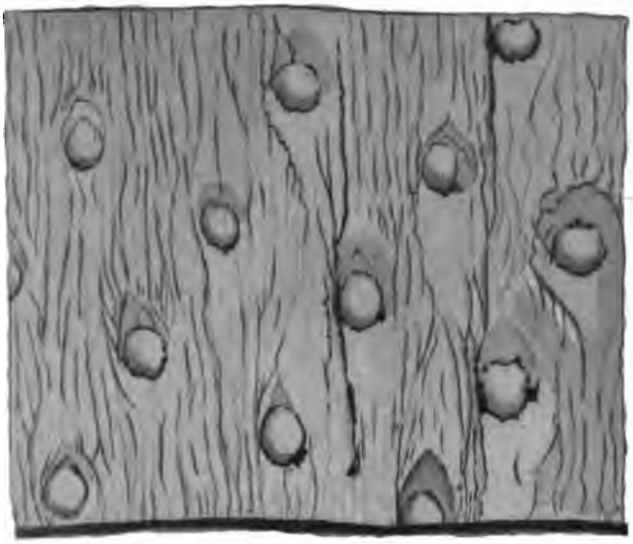
Fig. 1. LEPIDODENDRON MAMMILLATUM, Spec. nov.................................432

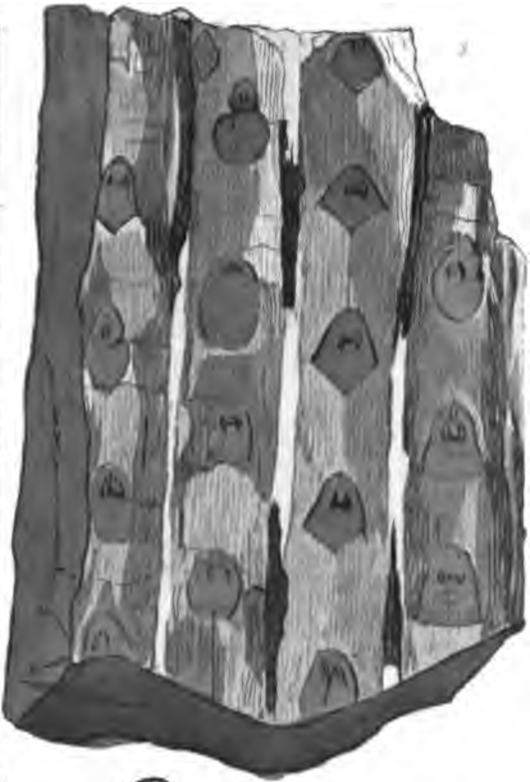
Fig. 2. LEPIDODENDRON CRUCIATUM, Spec. nov.................................432

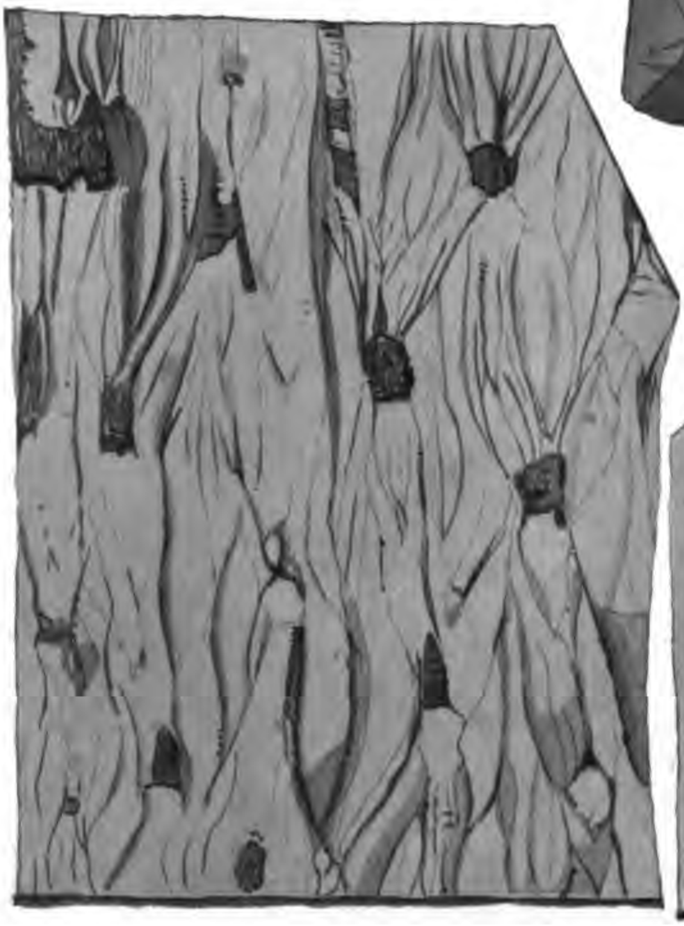
Fig. 3. SIGILLARIA MASSILIENSIS, Spec. nov.................................446

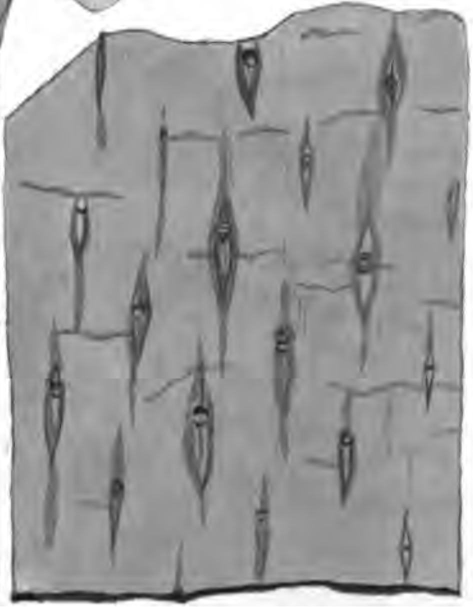
Fig. 4. Scar of the same, enlarged.

Fig. 5. SIGILLARIA CORRUGATA, Spec. nov., decorticated.................................445









5

PLATE XXVI.

PAGE.

Fig. 1. LEPIDOPHLOIOS PROTUBERANS, Spec. nov 440

Fig. 2. Uncovered scar of the same, full size.

Fig. 3. CAULOPTERIS? ACANTOPHORA, Spec. nov.....................................456

Fig. 4. Branch of the same.

Fig. 5. SIGILLARIA (Knorria) MONOSTIGMA, Lesqx...................................446

Fig. 6. LYCOPODITES MEEKII, Spec. nov.................... 426

Fig. 6*a*. Leaf of the same, enlarged four times.

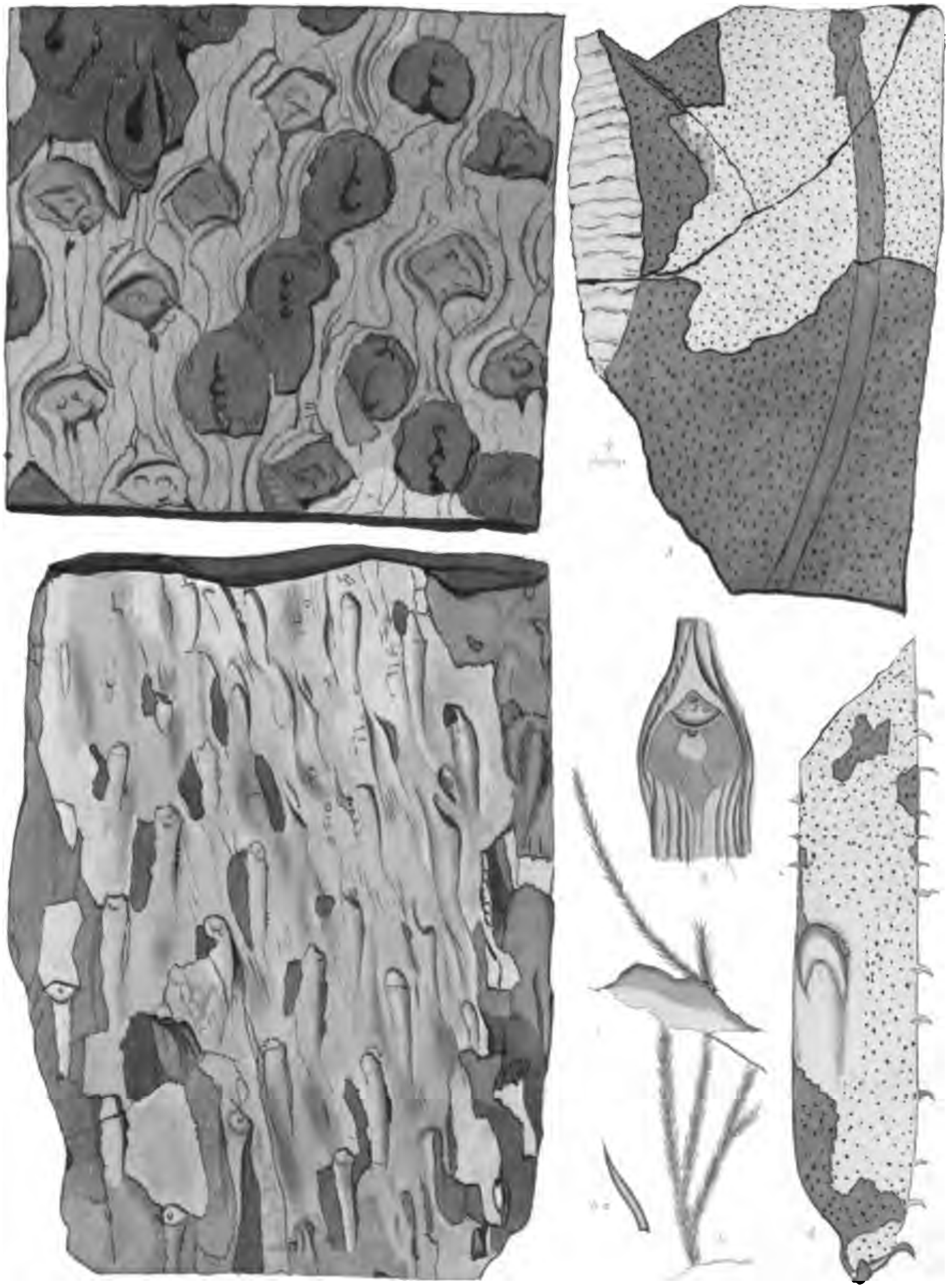


PLATE XXVII.

		PAGE.
Fig. 1.	LEPIDODENDRON RIGENS, with leaves	429
Fig. 2.	Scar and base of leaf, showing point of attachment.	
Fig. 3.	Enlarged section of a leaf of same, *b*.	
Fig. 4.	SYRINGODENDRON PORTERI, Spec. nov, half size	448
Fig. 5.	Part of the same, natural size.	
Fig. 6.	Cicatrices of the same, enlarged twice.	
Fig. 7.	LEPIDODENDRON GREENII, Spec. nov	433
Fig. 8.	Enlarged cicatrice of the same.	
Fig. 9.	STIGMARIOIDES AFFINIS, Spec. nov	455
Fig. 10 and 12.	PALÆOXYRIS PRENDELI, Spec. nov	464
Fig. 10 *b*.	Part of its surface, enlarged.	
Fig. 11.	PALŒOXYRIS APPENDICULATA, Spec. nov	465
Fig. 13.	PALÆOXYRIS CORRUGATA, Spec. nov	466

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS FOSSIL FLORA

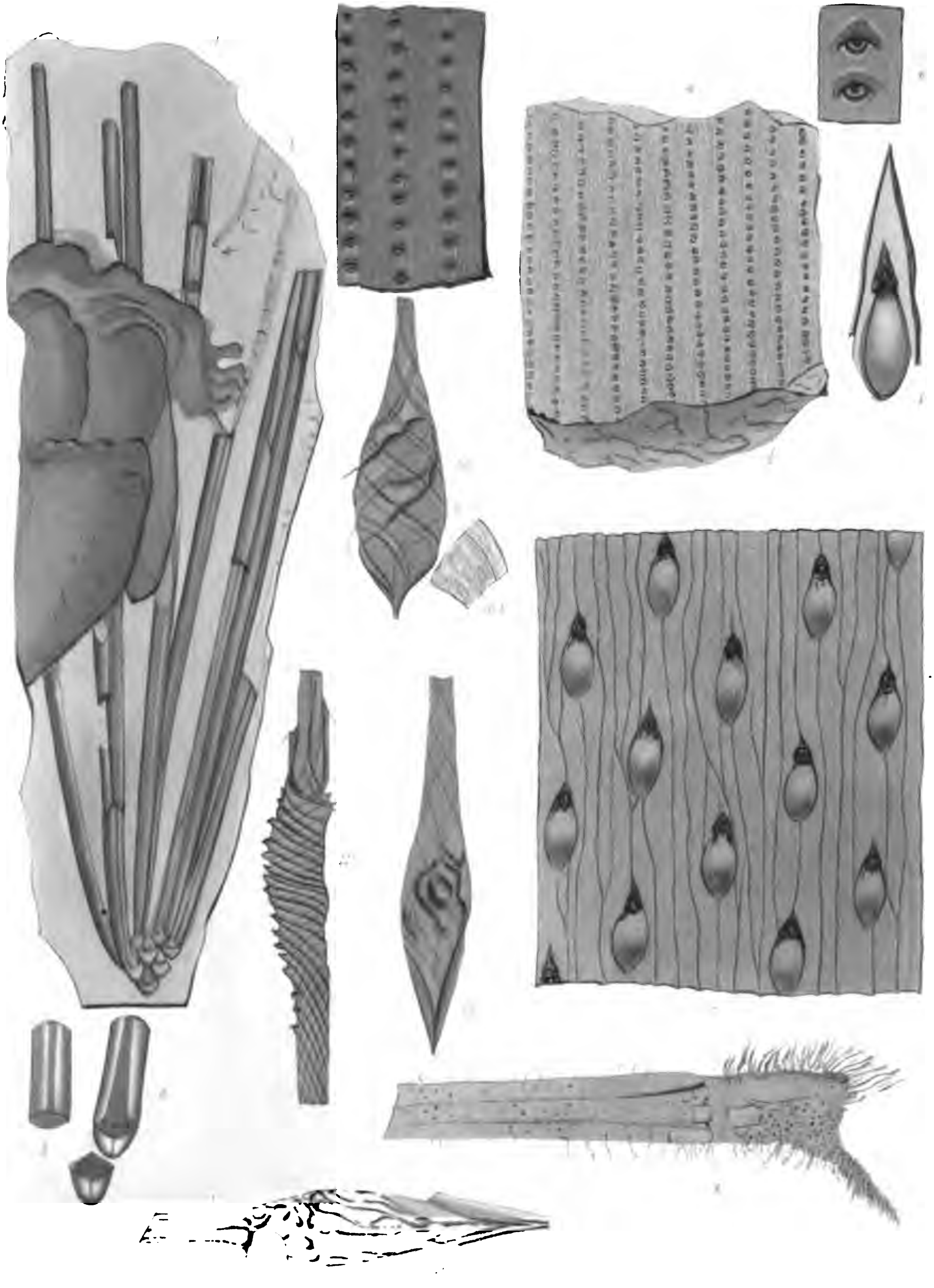


PLATE XXVIII.

PAGE.

Fig. 1. CAULOPTERIS OBTECTA, Spec. nov., one-fourth natural size 457

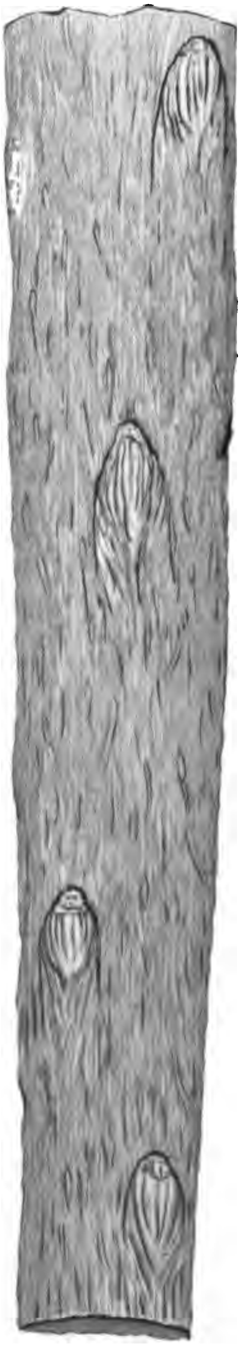
Fig. 2. Same specimen, on the reverse.

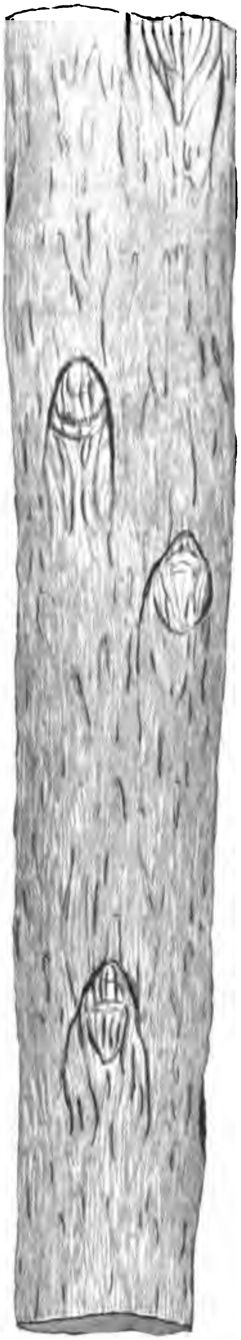
Fig. 3. Branch cicatrice of the same, natural size.

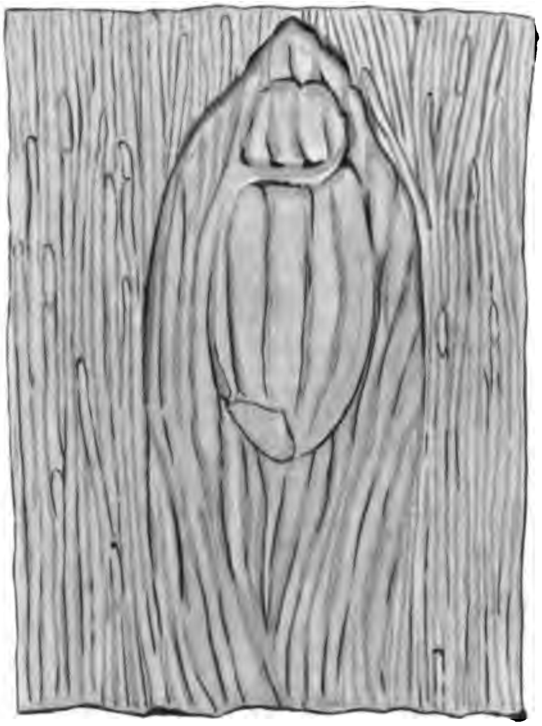
Fig 4. Part of the surface, showing rootlets in relative position, either naked, or with a carbonaceous pellicle.

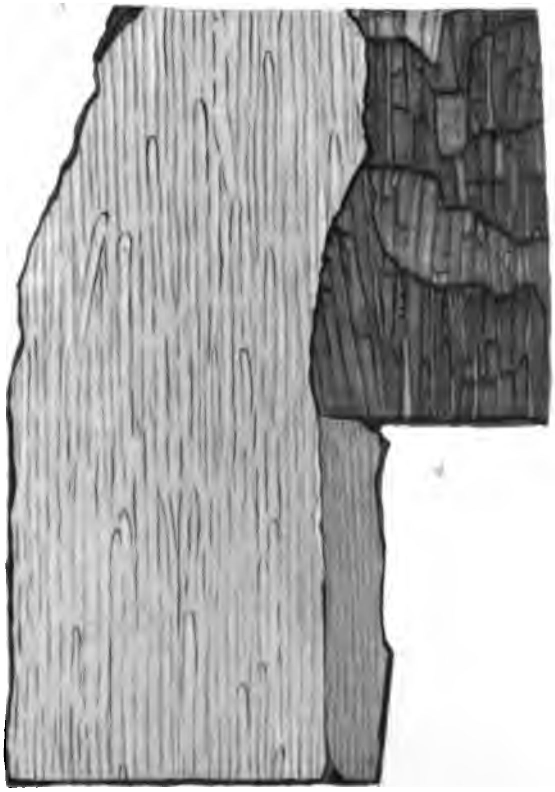
GEOLOGICAL SURVEY OF ILLINOIS

[illegible] [illegible]





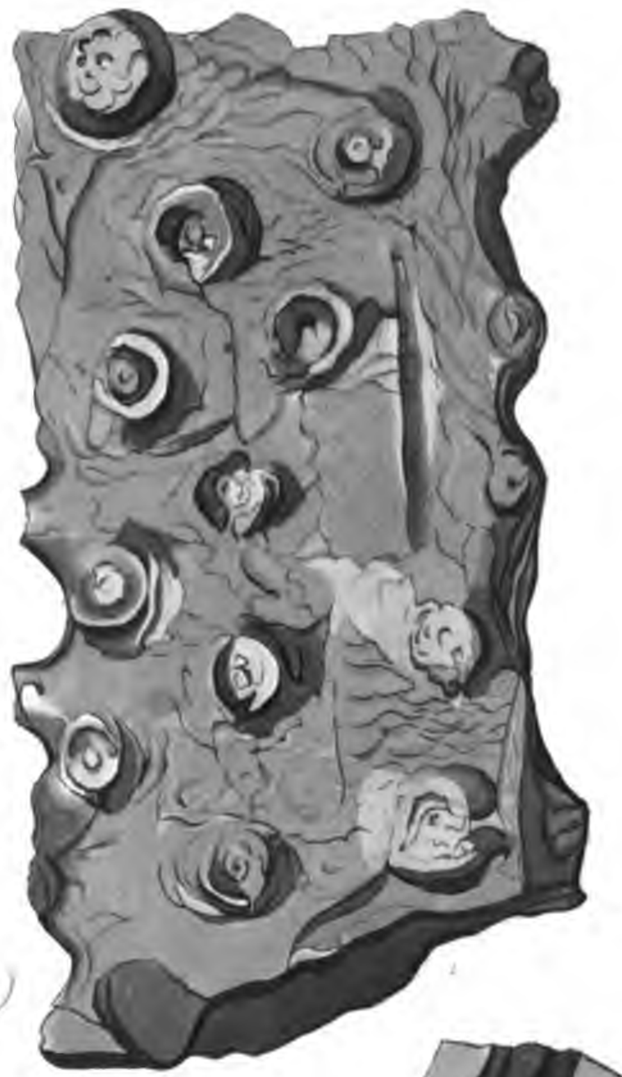


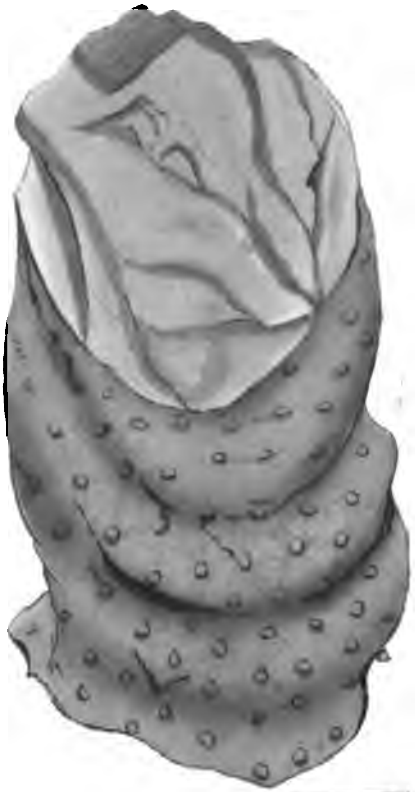


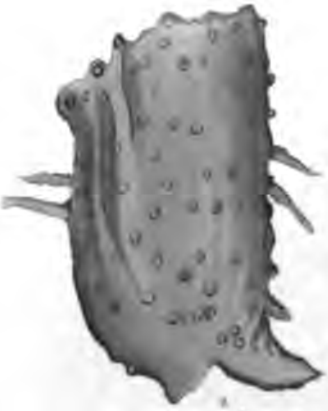
[illegible] [illegible] [illegible]

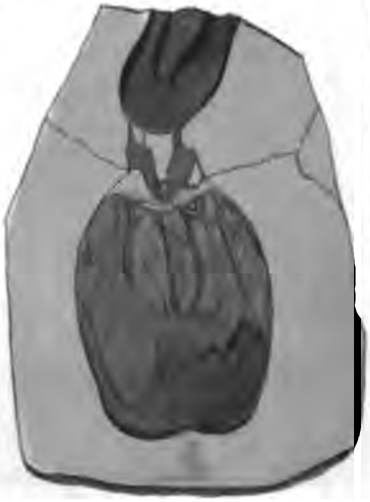
PLATE XXIX.

		Page.
Fig. 1.	HALONIA TUBERCULATA? Brgt	451
Fig. 2.	STIGMARIA ELLIPTICA, Spec. nov	451
Fig. 3.	SIGILLARIOIDES STELLARIS, Spec. nov	450
Fig. 4.	STIGMARIOIDES TRUNCATUS, Spec. nov	453
Fig. 5.	STIGMARIOIDES TUBEROSUS, Spec. nov	453

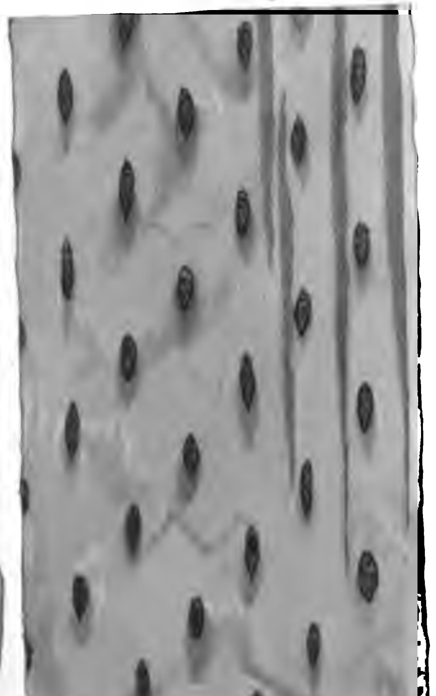








5



2

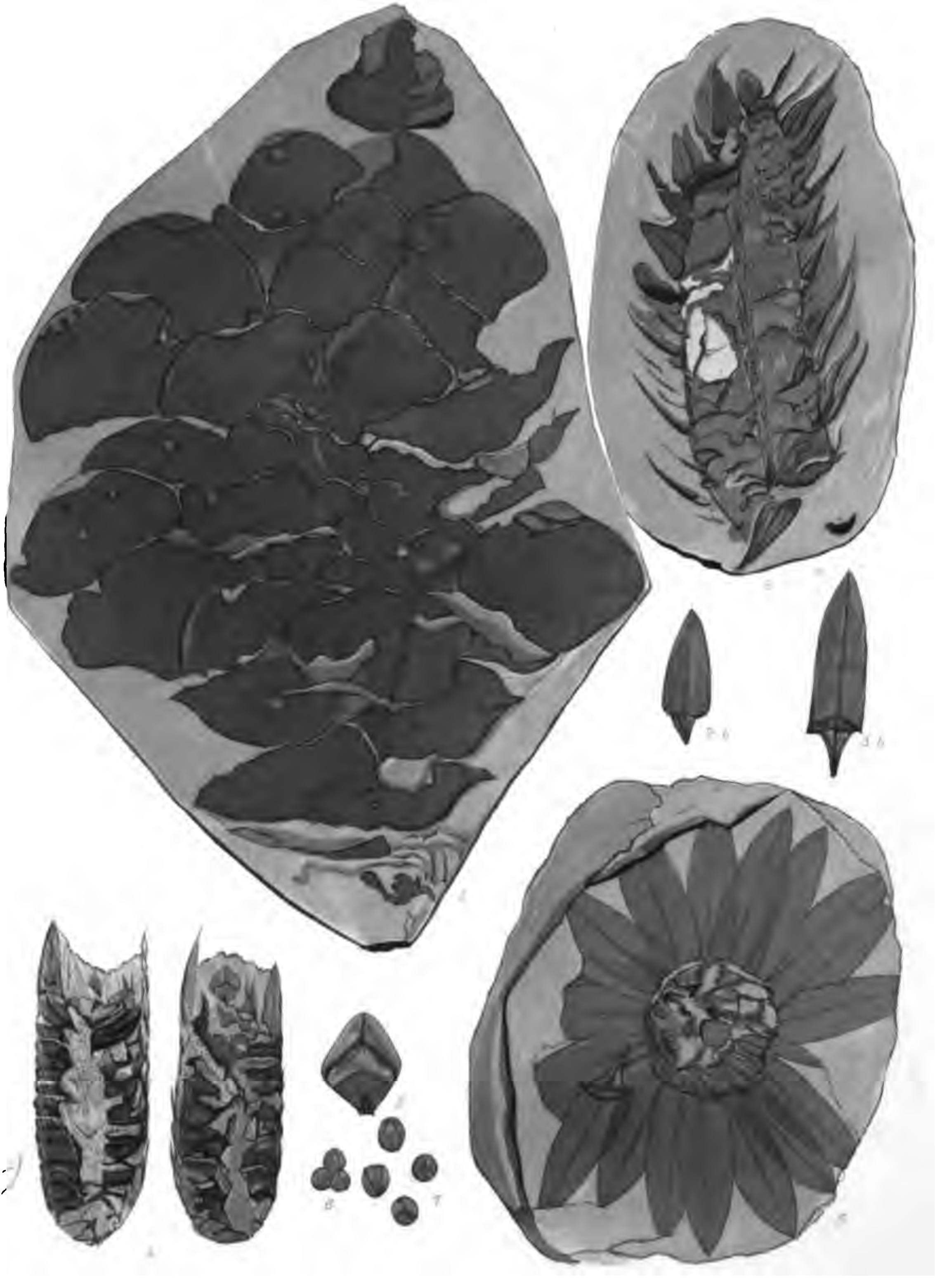
Leo Lesquereux del A H Worthen direxit Western Engraving Co Chicago

PLATE XXX.

		Page.
Fig. 1.	LEPIDOPHLOIOS AURICULATUM, Spec. nov	489
Fig. 2.	LEPIDOSTROBUS OVATIFOLIUS, Spec. nov	441
Fig. 2 *b*.	Blade and sporange—pedicel of the same.	
Fig. 3.	LEPIDOSTROBUS OBLONGIFOLIUS, Spec. nov	441
Fig. 3 *b*.	Blade and sporange—pedicel of the same.	
Fig. 4.	LEPIDOSTROBUS SPECIES?	440
Fig. 5.	Scale of a sporange? enlarged.	
Fig. 6 and 7.	Spores of the same, much enlarged.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS — Coal Meas[illegible] — FOSSIL FLORA



A. H. Worthen, direxit — Western Engraving Co. Chicago

PLATE XXXI.

		Page.
Fig 1.	Stigmarioides villosus, Spec. nov	454
Fig. 2.	Stigmarioides linearis, Spec. nov	455
Fig. 3.	Stigmarioides selago, Spec. nov	456
Fig. 3 *b*.	Enlarged scale of the same.	
Fig. 4.	Sigillarioides radicans, Spec. nov	449
Fig. 5.	Lepidostrobus truncatus, Spec. nov	442
Fig. 6.	Lepidostrobus connivens, Spec. nov	442
Fig. 7.	Lepidostrobus lancifolius, Spec. nov	442
Fig. 8.	Lepidophyllum rostellatum, Spec. nov	443
Fig. 9.	Lepidophyllum striatum, Spec. nov	443
Fig. 10.	Lepidophyllum foliaceum, Spec. nov	444
Fig. 11.	Rhabdocarpos clavatus? Sternb	461
Fig. 12 to 15.	Rhabdocarpos mammillatus, Spec. nov	461
Fig. 16.	Trigonocarpum Nœggerathii, Ll. and Hutt	460
Fig. 17,	Carpolithes corticosus, Spec. nov.	462
Fig. 18.	Carpolithes persicaria, Spec. nov	462
Fig. 19 to 21.	Carpolithes vesicularis, Spec. nov	462
Fig. 22 to 23.	Carpolithes bullatus, Spec. nov.	463
Fig. 24.	Same, enlarged.	
Fig. 25.	Receptacle and seeds of Sigillaria?	463
Fig. 25 *a*.	Seeds enlarged 5 times.	

GEOLOGICAL SURVEY OF ILLINOIS

CARBONIFEROUS

COAL FLORA